Quality Assurance Project Plan

Lower Fox River Pre-Design Characterization Study
Lower Fox River, Wisconsin

Volume 1

Prepared for:

Wisconsin Department of Natural Resources

and

United States Environmental Protection Agency
Region V Superfund

Prepared by:

The RETEC Group, Inc.
MAKuehl Company
En Chem, Inc.
Natural Resource Technology, Inc.

November 2003

Quality Assurance Project Plan

Lower Fox River Pre-Design Characterization Study
Lower Fox River, Wisconsin

Prepared by:

The RETEC Group, Inc.
22 North Carroll, Suite 370
Madison, Wisconsin 53703

MAKuehl Company
3470 Charlevoix Court
Green Bay, Wisconsin 54311

En Chem, Inc.
1241 Bellevue Street, Suite 9
Green Bay, Wisconsin 54302

Natural Resource Technology, Inc.
23713 West Paul Road, Unit D
Pewaukee, Wisconsin 53072

RETEC Project Number: WISC2-16495-120

Prepared for:

Wisconsin Department of Natural Resources
101 S. Webster Street
Madison, Wisconsin 53703

U.S. Environmental Protection Agency
Region 5 Superfund
77 W. Jackson Boulevard
Chicago, Illinois 60604

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23713 West Paul Road, Unit D
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RETEC Project Number: WISC2-16495-120

Prepared for:

Wisconsin Department of Natural Resources
Northeast Region
1125 N. Military Avenue
Green Bay, Wisconsin 54307

U.S. Environmental Protection Agency
Region 5 Superfund
77 W. Jackson Boulevard
Chicago, Illinois 60604

Prepared by:

_____
Marcia Kuehl, RETEC QA Manager

Reviewed by:

_____
Robert Paulson, Project Manager

November 2003

Table of Contents

Table of Contents

List of Tables

List of Figures

List of Appendices

QUALITY ASSURANCE PROJECT PLAN APPROVAL SHEET

On behalf of the Wisconsin Department of Natural Resources (WDNR) and the U.S. Environmental Protection Agency Region 5 Superfund Division (USEPA), The RETEC Group, Inc. (RETEC) prepared this Quality Assurance Project Plan (QAPP) for the Lower Fox River Pre-Design Characterization Study (LFRPD). The QAPP was developed following the guidance presented in the United States Environmental Protection Agency (USEPA) documents entitled *Instructions on the Preparation of a Superfund Division Quality Assurance Project Plan* and EPA Region 5 *Instructions on the Preparation of a Superfund Division Quality Assurance Project Plan, Revision 0, June 2000*. It was also designed to be consistent with *EPA Requirements for Quality Assurance Project Plans* (QA/R-5—Interim Final), *EPA Guidance for Quality Assurance Project Plans* (QA/G-5, 1994), *EPA Quality Manual for Environmental Programs (EPA 5360)*, and *Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs,* American National Standards Institute (ANSI/ASQC E4-1994). This QAPP is applicable to Operable Units 3 (OU 3) and 4 (OU 4) and specifies those requirements that are applicable to both Operable Units. A separate Sampling and Analysis Plan (SAP) details the requirements that are specific to each Operable Unit.

This QAPP was submitted to WDNR by RETEC on November 24, 2003.

_____
USEPA Region 5 Remedial Project Manager

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USEPA Region 5 QA Reviewer

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WDNR Project Manager

_____
WDNR QA Manager

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RETEC Project Manager

_____
RETEC QA Manager

_____
En Chem Laboratory Project Manager

DISTRIBUTION LIST

In accordance with the USEPA Region 5 QMP, the distribution of site QA Project Plans will be controlled to ensure that implementing individuals have direct access to the most recently approved version. This QAPP includes the list of individuals to whom the plan and subsequent revisions are issued. Recipients will typically include the signatories and key project personnel, including those of subcontractors and technical suppliers. A copy of this QAPP will also be purged of the sampling numbering system and site location information and then provided to the supporting analytical laboratories for reference and to communicate project requirements.

Copies have been distributed to the following:

Jim Hahnenberg, USEPA Region 5 Remedial Project Manager (2 copies)
USEPA Region 5 QA Reviewer (c/o Jim Hahnenberg, USEPA Region 5 Remedial Project Manager)
Ben Hung, WDNR Project Manager (8 copies)
WDNR QA Manager (c/o Ben Hung, WDNR Project Manager)
Robert Paulson, RETEC Project Manager
Marcia Kuehl, RETEC QA Manager
Rick Fox, Natural Resources Technology
Tod Noltemeyer, En Chem Laboratory Project Manager

List of Acronyms

ANSI	American National Standards Institute
ARI	Analytical Resources, Inc.
ASTM	American Society for Testing and Materials
BLRA	Baseline Risk Assessment
BOD	Biochemical Oxygen Demand
BODR	Basis of Design Report
cm	centimeter
CCV	Continuing Calibration Verification
CERCLA	Comprehensive Environmental Response, Cleanup, and Liability Act
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
COC	Chain of Custody
COD	Chemical Oxygen Demand
CQM	CQM, Inc.
DDE	4,4'-dichlorodiphenyl dichloroethylene
DDT	4,4'- dichlorodiphenyl trichloroethane
DGPS	differential global positioning system
DI	Deionized water
DOC	Dissolved Organic Carbon
DQOs	Data Quality Objectives
EDD	Electronic Data Deliverable
EPA	United States Environmental Protection Agency
EIMS	Electronic Information Management System
FRDB	Fox River Database
FRG	Fox River Group
FS	Feasibility Study
GIS	Geographic Information System
HASP	Health and Safety Plan
ID	identification
IWMP	Investigative Waste Management Plan
LFRPD	Lower Fox River Pre-design Characterization Study
LOD	Limit of Detection
LOQ	Limit of Quantitation
MDL	Method Detection Limit
mg/kg	milligram per kilogram
MS	Matrix Spike
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NAD	North American Datum
NAVD	North American Vertical Datum
NCR	National Cash Register Corporation
NELAC	National Environmental Laboratory Accreditation Program
NEIC	National Enforcement Investigation Center
NIST	National Institute of Standards Technology
NRT	Natural Resources Technology

List of Acronyms

OSHA	Occupational Safety and Health Administration
OU	Operable Unit
OU 1	Little Lake Butte des Morts
OU 2	Appleton dam to Little Rapids dam
OU 3	Little Rapids dam to De Pere dam
OU 4	De Pere dam to mouth of the Lower Fox River
OU 5	Green Bay from the mouth of the Lower Fox River to its confluence with Lake Michigan
PAHs	Polycyclic Aromatic Hydrocarbons
PE	performance evaluation
PCB	Polychlorinated Biphenyls
PPE	Personal Protective Equipment
ppm	parts per million
PRAP	Preliminary Remedial Action Plan
PRP	Potentially Responsible Party
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
QAP	Quality Assurance Plan
QAPP	Quality Assurance Project Plan
QC	Quality Control
QMP	Quality Management Plan
r	correlation coefficient
%R	Percent Recovery
RETEC	The RETEC Group
RL	Reporting Limit
ROD	Record of Decision
RPD	Relative Percent Difference
RTK	real-time kinematics
SAP	Sampling and Analysis Plan
SBLT	Sequential Batch Leach Test
SET	Soil Engineering Testing, Inc
SMU	Sediment Management Unit
SOP	Standard Operating Procedure
SRM	Standard Reference Material
TOC	Total Organic Carbon
USACE	United States Army Corps of Engineers
USDOT	United States Department of Transportation
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
VOCs	Volatile Organic Compounds
WDNR	Wisconsin Department of Natural Resources
WTM	Wisconsin Transverse Mercator
XRF	X-Ray Fluorescence

1 Project Management

The purpose of this Quality Assurance Project Plan (QAPP) is to describe the personnel, procedures, and methods for determining the quality, accuracy, and precision of data that will be collected during the LFRPD. Following the procedures outlined in this QAPP will ensure that the project data meet United States Environmental Protection Agency Region 5 (USEPA) and the Wisconsin Department of Natural Resources (WDNR) standards. Following the procedures outlined in the QAPP will also provide sufficient data of adequate quality to allow the WDNR and USEPA to make confident decisions about the remedial alternatives for the Lower Fox River Operable Units 3 and 4. Required approvals for this QAPP include the USEPA Region 5 Remedial Project Manager and the WDNR Project Manager. Environmental sampling may not begin until these approvals have been obtained in writing. Revisions of, or addenda to, this approved QAPP will be subject to the same level of review and approval as the original.

A separate Sampling and Analysis Plan (SAP) is the companion document to this QAPP. The SAP details the field sampling locations, rationale for selection, sample density (number of cores per acre) and core intervals for analysis, sample collection procedures, number, frequency and location of field replicates (co-located cores), and core processing procedures for dredge prism determination, engineering data purposes and preliminary disposal characterization purposes. A description of the engineering testing that will be conducted on the cores; field data management procedures, sample equipment decontamination protocols and Investigational Waste Management Plan (IWMP) is also included in the SAP.

Where a major QAPP element is not applicable to the LFRPD, the element will still be included in this QAPP with a brief explanation of why it is not applicable. In this manner The RETEC Group (RETEC) will ensure that all required elements are addressed appropriately and that users can anticipate a standardized format and content, thereby facilitating the review and approval process. Elements that are addressed in detail in the SAP will refer to the specific section of the SAP where it is discussed to aid in the review and approval process.

1.1 Project Organization and Responsibility

The USEPA and WDNR share responsibility for the completion of the study. The WDNR is tasked with planning, conducting and overseeing all work. USEPA has an obligation to review the study planning documents and provide additional oversight as they deem necessary. WDNR has retained RETEC as the consultant for development of the study planning documents (QAPP and SAP). In order to write the QAPP and SAP, names of personnel from the

RETEC team have been included. If other entities will implement the QAPP and SAP, a list of the replacement personnel and subcontractors in these roles will need to be submitted to WDNR and USEPA to update the QAPP and SAP. Figure 1 presents the organizational structure for the team of USEPA, WDNR, and the RETEC Team personnel involved in the study. RETEC is listed as responsible for conducting the field sampling, laboratory analysis, quality assurance oversight, engineering design and records management. These tasks will be accomplished through several subcontractors and conducted by Task Managers (engineering design testing, geophysical investigations, records management), QA Manager (data validation), Field Team Leader (field sampling, physical and chemical testing) and Project Manager (sediment analysis for PCBs).

All lines of communication between the project team members will follow the organizational structure in Figure 1. The USEPA Remedial Project Manager will communicate any comments and instructions directly to the WDNR Project Manager.

In turn, the WDNR Project Manager will convey these comments and instructions to the RETEC Project Manager. The WDNR Project Manager must approve all proposed changes in personnel.

Responsibilities of key project personnel are outlined below:

USEPA Remedial Project Manager:
Jim Hahnenberg, USEPA Region 5 Remedial Project Manager
Hahnenberg.james @epamail.epa.gov
77 West Jackson Blvd.
Chicago, IL 60604

- Direct review and approval of QAPP and SAP
- Provide technical assistance to the WDNR and the RETEC Project Manager
- Review progress reports detailing work accomplished
- Review all reports in draft version prior their final edition

USEPA Quality Assurance (QA) Reviewer:
In care of: Jim Hahnenberg, USEPA Region 5 Remedial Project Manager
Hahnenberg.james@epamail.epa.gov
77 West Jackson Blvd.
Chicago, IL 60604

- Review and approve the QAPP
- Assist in review of SAP

WDNR QA Officer:
In care of: Ben Hung, WDNR Project Manager
Ben.Hung@dnr.state.us
Wisconsin Department of Natural Resources
101 S. Webster St., Box 7921
Madison, WI 53703-7921
Phone #: 608-267-0700
Fax #: 608-267-2800

- Review and approve the QAPP
- Assist in review of SAP
- Set audit schedule

Communicate with the USEPA Quality Assurance Reviewer on issues and questions arising during QAPP preparation

WDNR Project Manager:
Ben Hung, WDNR Project Manager
Ben.Hung@dnr.state.us
Wisconsin Department of Natural Resources
101 S. Webster St., Box 7921
Madison, WI 53703-7921
Phone #: 608-267-0700
Fax #: 608-267-2800

- Direct all project activities
- Communicate with stakeholders
- Prepare and submit progress reports detailing work accomplished, funds spent, and the project status
- Review all project deliverables, plan and/or approve project strategies

- Review all site reports for consistency with objectives stated in the QAPP and SAP

- Sign all final reports

RETEC Quality Assurance Manager:
Marcia Kuehl
makuehl@aol.com
MAKuehl Company
3470 Charlevoix Ct.
Green Bay, Wisconsin 54311
Phone #: (920) 469-9113
Fax #: (920) 469-9113

- In order to assure independent QA oversight for the LFRPD project, Marcia Kuehl of the MAKuehl Company will serve as the RETEC QA Manager, and will report directly to the WDNR and USEPA Project Managers.

- Audit field activities to ensure that sampling methodology, sample preservation methods, and COC procedures are being followed

- Conduct laboratory data validation

- Assist in resolving QA issues with field or laboratory personnel

- Conduct on-site laboratory audits before and during LFRPD sample analyses

RETEC Project Manager:
Robert Paulson
Rpaulson@RETEC.com
The RETEC Group, Inc.
22 North Carroll, Suite 370
Madison, Wisconsin 55703
Phone #: 608-255-0805
Fax #: 608-255-0806

- Plan, coordinate, monitor, and evaluate all project activities

- Prior to fieldwork, meet with WDNR Project Manager, QA Manager, and field staff to discuss and establish sampling purposes, sampling methodology, number of samples, size of samples, sample preservation methods, chain-of-custody (COC)

requirements, analyses required, and which locations will be selected for co-located samples

- Resolve all technical problems during the course of the project
- Meet with team members to discuss and review analytical results prior to completion of final reports
- Maintain personnel training record.

RETEC Records Management Task Manager:
Lori Upgren
Lupgren@RETEC.com
The RETEC Group, Inc.
413 Wacouta Street
Saint Paul, MN 55101-1644
Phone #: 651-222-0841

- Maintain a record of all samples collected and the sample identification information on each sample
- Maintain a record of all samples submitted to the laboratory, the analyses being performed on each sample, the final analytical results, and the data validation reports
- Manage data acquired from field investigations
- Assemble data into tables that can be incorporated in the final reports

RETEC Electronic Data Manager:
Scott Elvin
Selvin@RETEC.com
The RETEC Group, Inc.
413 Wacouta Street
Saint Paul, MN 55101-1644
Phone #: 651-222-0841

- Assist in maintenance of records for all samples collected and the sample identification information on each sample
- General maintenance of sample records submitted to the laboratory, the analyses being performed on each sample, the final analytical results, and the data validation reports

- Assist in data managerial duties for data acquired from field investigations

- Assemble data into tables that can be incorporated in the final reports

Engineering Design Testing Task Manager:
Fred Swed, P.E.
fmspe@inxpress.net
6313 Appalachian Way
Madison, Wisconsin 53705
Phone #: 608-218-9615

- Review the QAPP and SAP prior to commencement of field activities at each Operable Unit (OU) with field team

- Maintain personnel training records

- Consult with the Technical Advisors regarding engineering tasks and data obtained

- Submit all data generated during investigations to the RETEC Data Manager

Technical Advisors:
Dr. Michael Palermo
103 Beaver Creek Lane
Vicksburg, MS 39180
Phone #: 601-634-3753
Fax #: 601-634-3707

Greg Hartman
Dalton, Olmsted, and Fuglevand, Inc.
10827 NE 68th Street, Suite B
Kirkland, WA 98033
Phone #: 425-827-4588
Fax #: 425-739-9885

- Maintain personnel training records

- Consult with the Engineering Design Testing Task Manager regarding engineering tasks and data obtained

- Review all Engineering Design tasks in regards engineering investigative work

RETEC Geophysical Task Manager:
Matthew Meyer
Mmeyer@RETEC.com
The RETEC Group, Inc.
22 North Carroll, Suite 370
Madison, Wisconsin 55703
Phone #: 608-255-0805
Fax #: 608-255-0806

- Review the QAPP and SAP prior to commencement of field activities at each OU with field team
- Coordinate geophysical activities with subcontractors
- Oversee geophysical survey work to ensure that proper procedures are followed during data acquisition
- Interpret data acquired during fieldwork
- Submit all data generated during field investigation to the RETEC Data Manager

ONYX Special Services:
Trent Nedens
ONYX Special Services
TJNedens@onyxsp.com
2135 West Nordale Drive
Appleton, Wisconsin 54914
Phone #: 920-749-8100

- Prior to fieldwork, meet with RETEC Geophysical Team Leader to discuss sampling purpose, sampling methodology used in the field
- Prepare equipment needed for fieldwork, including personal protective equipment (PPE), sampling equipment, survey instruments, and any other equipment deemed necessary
- Oversee geophysical survey work to ensure that proper procedures are followed during data acquisition
- Monitor for hazardous conditions while conducting field operations and comply with the Health and Safety Plan (HASP)
- Submit all data records and field paperwork to field team leader

Natural Resources Technology (NRT) Field Team Leader:
Rick Fox
rfox@naturalrt.com
Natural Resources Technology
23713 West Paul Road
Suite D
Pewaukee, Wisconsin 53072
Phone #: 262-523-9003
Mobile #: 262-719-4503
Fax #: 262-523-9000

- Review the QAPP and SAP prior to commencement of field activities at each OU with field team
- Oversee all field activities and ensure that all procedures as described in the QAPP and SAP are executed and documented properly
- Coordinate sample pickup by the regional project laboratories
- Select and prepare samples for shipping to non-regional laboratories
- Submit all data generated during field investigation to the RETEC Data Manager
- Maintain personnel training records

RETEC Technical Staff:
Matthew Meyer
Mmeyer@RETEC.com
Paula Munson
Pmunson@RETEC.com
The RETEC Group, Inc.
22 North Carroll, Suite 370
Madison, Wisconsin 55703
Phone #: 608-255-0805

- Prior to fieldwork, meet with RETEC Project Manager to discuss sampling purpose, sampling methodology, number of samples, size of samples, sample preservation methods, COC requirements, analyses required, and which samples will be duplicated and/or co-located in the field

- Prepare equipment needed for fieldwork, PPE, sampling equipment, sample containers and coolers, sample collection documentation, monitoring devices, and any other equipment deemed necessary

- Oversee sediment boring work to ensure that proper procedures are followed during sediment sample collection

- Monitor for hazardous conditions while conducting field operations and comply with the HASP

- Submit all COC records and field paperwork to field team leader

CQM Inc. Laboratory Project Manager:
Bob Rouse
Rouse@cqminc.com
CQM Inc.
2679 Continental Drive
Green Bay, Wisconsin 54311
Phone #: 920-465-3911
Fax. #: 920-465-3913

- Responsible for evaluating adherence to policies and ensuring that systems are in place to provide QA/QC as defined in the QAPP

- Ensure that laboratory personnel understand technical requirements, including COC procedures

- Initiate and oversee audits of corrective action procedures

- Perform data reviews

- Maintain documentation of training

Axys Laboratory Project Manager:
L. Phillips
lphillips@axys.com
Axys Laboratory
2045 Mills Road.
Sidney, British Columbia
Canada V8L 3S8
Phone #: 250-655-5800
Fax. #: 250-655-5811

- Be responsible for evaluating adherence to policies and ensuring that systems are in place to provide QA/QC as defined in the QAPP

- Ensure that laboratory personnel understand technical requirements, including COC procedures

- Initiate and oversee audits of corrective action procedures

- Perform data reviews

- Maintain documentation of training

Analytical Resources, Inc. Laboratory Project Manager:
Harrold Benny
haroldb@arilabs.com
Analytical Resources, Inc.
4611 S. 134th Place
Tukwila, Washington 98168-3240
Phone #: 206-621-6490
Fax #: 206-621-7523

- Responsible for evaluating adherence to policies and ensuring that systems are in place to provide QA/QC as defined in the QAPP

- Ensure that laboratory personnel understand technical requirements, including COC procedures

- Initiate and oversee audits of corrective action procedures

- Perform data reviews

- Maintain documentation of training

Soil Engineering Testing Laboratory Project Manager:
Gordan Eischens
Soil Engineering Testing
9301 Bryant Ave. South
Suite 107
Bloomington, Minnesota 55420-3436
Phone #: 612-881-6833
Fax #: 612-884-6923

- Responsible for evaluating adherence to policies and ensuring systems are in place to provide QA/QC as defined in the QAPP

- Ensure that laboratory personnel understand technical requirements, including COC procedures
- Initiate and oversee audits of corrective action procedures
- Perform data reviews
- Maintain documentation of training

The Mineral Lab Laboratory Project Manager:
Peggy Doll
tmico@theminerallab.com
The Mineral Lab
2700 Youngfield, Suite 105
Lakewood, Colorado 80215
Phone #: 303-232-8708
Fax #: 303-232-2033

- Be responsible for evaluating adherence to policies and ensuring that systems are in place to provide QA/QC as defined in the QAPP
- Ensure that laboratory personnel understand technical requirements, including COC procedures
- Initiate and oversee audits of corrective action procedures
- Perform data reviews
- Maintain documentation of training

En Chem Laboratory Project Manager:
Tod Noltemeyer
TNoltemeyer@enchem.com
En Chem, Inc.
25 Kessel Court, Suite 105
Madison, Wisconsin 53711
Phone #: 800-736-2436
Fax. #: (608) 233-0502

- Responsible for summarizing quality assurance/quality control (QA/QC) requirements for the project
- Provide technical guidance to RETEC Project Manager and RETEC QA manager

- Review laboratory data for compliance with the QAPP

En Chem Laboratory Quality Assurance Manager:
Julie Trivedi
JTrivedi@enchem.com
En Chem, Inc.
25 Kessel Court, Suite 105
Madison, Wisconsin 53711
Phone #: 800-736-2436
Fax. #: (608) 233-0502

- Responsible for evaluating adherence to policies and ensuring that systems are in place to provide QA/QC as defined in the QAPP
- Ensure that laboratory personnel understand technical requirements, including COC procedures
- Initiate and oversee audits of corrective action procedures
- Perform data reviews
- Maintain documentation of training

MAKuehl Company Data Validator:
Marcia Kuehl
makuehl@aol.com
MAKuehl Company
3470 Charlevoix Ct.
Green Bay, Wisconsin 54311
Phone #: (920) 469-9113
Fax #: (920) 469-9113

- Conduct data validation
- Prepare data validation reports
- Provide data clarification requests to the laboratory to resolve data and documentation gaps discovered during validation.

1.2 Training Requirements, Qualifications and Certifications

As appropriate to their responsibilities, project personnel will be proficient in relevant aspects of sample collection, shipping, handling, and analysis; data reporting, management, and validation; and the related quality control (QC)

requirements and practices. The technical staff will be provided with and required to read the QAPP, SAP, HASP and applicable SOPs. Each member of the technical staff must demonstrate proficiency with their assigned duties to include the preparation of associated documentation. Skills and knowledge needed by each key RETEC technical staff in Figure 1 are as follows:

RETEC Project Manager: degreed scientist or engineer with knowledge of the history of Fox River investigations and geology.

QA Manager/Data Validator: degreed chemist with knowledge of statistical process quality control and EPA data validation, field auditing and laboratory auditing procedures, experience in field sampling and environmental laboratory analysis.

Laboratory Project Manager: degreed scientist with hands on experience with Fox River Method.

Field Team Leader: degreed scientist or engineer with OSHA Supervisory training and knowledge of Fox River geology, applicable drilling techniques and subcontractor management.

Engineering Design Testing Task Manager: degreed engineer with experience in remedial alternatives design.

Geophysical Task Manager: degreed scientist with geophysical testing field and laboratory experience.

Records Management Task Manager: degreed professional with bookkeeping and records management training, knowledge of WDNR and EPA requirements for documentation

All on-site personnel will be trained as mandated by the Occupational Safety and Health Administration (OSHA) Act regulations (29 Code of Federal Regulations (CFR) 1910.120) and certified as completing the Hazardous Material Site Worker Training (40-hour initial training and current 8-hour annual refreshers). Field supervisory personnel will also be certified and current in the OSHA Hazardous Material Supervisor Training (8-hour initial training and 8-hour annual refresher alternating with site worker refresher). Additionally, all site personnel will be properly trained in the procedures for collecting, labeling, packaging, and shipping of liquid and solid environmental samples. The Field Team Leader will maintain these personnel training records.

Minimum qualifications for personnel performing inspections, audits, or other project QA/QC activities will be established and enforced by the RETEC QA Manager. The RETEC QA Manager will generate and maintain a list of

project personnel who have been qualified as auditors and inspectors, as well as their particular areas of expertise.

Laboratories providing chemical measurements for the purposes of determining the dredge prism must be certified for polychlorinated biphenyls (PCBs) by the State of Wisconsin. All laboratory methods must meet the detection limit requirements acceptable to both the USEPA and WDNR. The certified laboratory selected for all of the chemical analysis for this project except for PCB congeners is En Chem, located at the following address:

25 Kessel Court, Suite 105
Madison, Wisconsin 53711
Phone #: 800-736-2436
Fax. #: (608) 233-0502
Email: TNoltemeyer@enchem.com

En Chem is a WDNR-certified laboratory for PCBs, metals, biochemical oxygen demand (BOD), chemical oxygen demand (COD), ammonia, volatile organics (VOCs), total organic carbon (TOC), and polycyclic aromatic hydrocarbons (PAH). A copy of the current WDNR Laboratory Certification is included as an appendix to the En Chem's Statement of Qualifications and Quality Assurance Plan (QAP) that is included as Appendix A to this QAPP.

The laboratory selected for PCB congener analysis is Axys, a National Environmental Laboratory Accreditation Program (NELAC) certified laboratory located at the following address:

2045 Mills Road W.
Sidney, British Columbia
Canada V8L 3S8
Phone #: 250-655-5800
Fax. #: 250-655-5811
Email: lphillips@axys.com

A copy of the current Axys Laboratory Certifications and Statement of Qualifications and Quality Assurance Plan (QAP) is included as Appendix A to this QAPP. As the congener results will be used for engineering purposes, State of Wisconsin certification is not critical.

The laboratory selected for the physical and geotechnical tests of bulk unit weight, percent solids, grain size, specific gravity, Atterberg Limits and the Proctor test is CQM, Inc., located at the following address:

2679 Continental Drive
Green Bay, Wisconsin 54311
Phone #: 920-465-3911
Fax. #: 920-465-3913

CQM, Inc. is a soils testing laboratory with experience in Lower Fox River sediment testing. CQM's Statement of Qualifications and Quality Assurance Plan (QAP) is included in Appendix B of this QAPP. No State of Wisconsin certification program currently exists for engineering and geotechnical soil testing laboratories.

The laboratory selected for triaxial compression tests is Soil Engineering Testing, Inc. (SET) located at the following address:

9301 Bryant Ave. South
Suite 107
Bloomington, Minnesota 55420-3436
Phone #: 612-881-6833
Fax #: 612-884-6923

SET's Statement of Qualifications and Quality Assurance Plan (QAP) is included in Appendix B of this QAPP. No State of Wisconsin certification program currently exists for engineering and geotechnical soil testing laboratories.

The laboratory selected for mineralogy analysis is The Mineral Lab, located at the following address:

2700 Youngfield
Suite 105
Lakewood, Colorado 80215
Phone #: 303-232-8708
Fax #: 303-232-2033
Email: tmico@theminerallab.com

The Mineral Lab's Statement of Qualifications and Quality Assurance Plan (QAP) are included in Appendix B of this QAPP. No State of Wisconsin certification program currently exists for mineralogy laboratories.

The laboratory selected for conducting the leaching tests on filter cake and sediment and providing pH and conductivity measurements of the resultant leachates is Analytical Resources, Inc (ARI), located at the following address:

4611 S. 134th Place
Tukwila, Washington 98168-3240
Phone #: 206-621-6490
Fax #: 206-621-7523
Email: sue@arilabs.com

ARI's Statement of Qualifications and Quality Assurance Plan (QAP) is included in Appendix B of this QAPP. No State of Wisconsin certification program currently exists for the leaching tests, and as the pH and conductivity results are used for engineering purposes only, state certification for them is not critical.

The MAKuehl Company will complete laboratory data validation. The MAKuehl Company is located at the following address:

3470 Charlevoix Ct.
Green Bay, Wisconsin 54311
Phone #: (920) 469-9113
Fax #: (920) 469-9113
Email: makuehl@aol.com

Technical Advisors for this project, Dr. Michael Palermo and Mr. Greg Hartman, will provide guidance, technology transfers, and review on project deliverables. The Technical Advisors' qualifications are as follows:

Dr. Michael Palermo, P.E. United States Army Corps of Engineers *(USACE) Waterways Experiment Station, Vicksburg, MS.* Dr. Palermo recently retired from the position of Director of the Center for Contaminated Sediments at the Corps' Waterways Experiment Station, and is an internationally recognized expert in sediment capping. As a senior scientist within the Corps specializing in contaminated sediment management, Dr. Palermo represented all facets of sediment management, including capping, removal, and confined disposal facility design and management.

Greg Hartman, P.E., *Dalton, Olmstead and Fugelvand, Ltd., Seattle, WA* Mr. Hartman has over 31 years of direct experience in waterway engineering, including projects for the Corps, the Navy, USEPA, and the Port of New York and New Jersey. Mr. Hartman also developed and taught dredging curriculum for the Corps of Engineers and the U.S. Navy. He is past President of the Western Dredging Association, and a member of the Technical Committee for the World Dredging Conference. Mr. Hartman's design and implementation

experience includes contaminated and navigation dredging, design of nearshore fills, confined aquatic disposal (CAD) sites, and capping.

NRT will direct the field sample collection for this project with assistance from RETEC technical staff. All NRT and RETEC on-site personnel shall have completed the applicable OSHA training. Additionally, NRT on-site personnel will be required to comply with all site safety regulations described in the site-specific HASP.

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1.3 Project Description and Schedule

The following pre-design characterization must be completed to achieve the goal of properly designing and initiating remedial actions throughout the Lower Fox River Operable Units:

- Accurately delineate the dredge prism that contains all sediments with 1 parts per million (ppm) or greater PCBs in OUs 1, 3, and 4
- Accurately delineate the dredge prism that contains all sediments with 50 ppm or greater PCBs in OUs 1, 3, and 4
- Identify in-water physical impediments (e.g., debris, pipelines, cables, in-water structures) to implementing both a capping or removal remedy in OUs 1, 3, and 4
- Determine chemical, physical and geotechnical properties in OUs 3, and 4 relating to:
  - Determine design considerations for application of a sediment cap in areas that meet the criteria described in both the Feasibility Study (FS) and Record of Decisions (ROD) for OUs 3 and 4.
  - Proper sizing of the dredge and associated pipeline including the number and location of booster pumps to reach shore based processing facilities
  - Dewatering and water treatment requirements

- Disposal requirements
- Parameters that control diffusive and advective flux for proper design of a cap
- Mineral composition for proper fluxing of sediment for vitrification option (Operable Units 3 (OU 3) and 4 (OU 4) only)
- Final effluent quality generated by specific wastewater treatment processes as a basis for discharge permitting
- Leachate quality of dewatered sediment for proper design of passive dewatering basin and/or landfill liner (OU 3 and OU 4 only)
- Develop location specific shear stresses for proper design of a cap armor layer

- Evaluate solids dewatering: filter press and belt press testing in OUs 3, and 4
- Evaluate physical and geotechnical properties of shore based support facilities
- Monument permanent benchmarks for horizontal and vertical controls in OUs 1, 3, and 4

The initial focus of the LFRPD will be almost exclusively in OU 1 to achieve the immediate goal: initiate remedy construction activities in 2004. Following completion of activities in OU 1, the pre-design characterization activities would proceed downstream into OU 3 and OU 4. Figure 2 presents the tentative project schedules to meet the scope of work discussed in SAP Sections 2.1 – 2.8. These project schedules are subject to change per completion of the deliverables, WDNR's direction, or issuance of notification to proceed. These project schedules reflect the approximate time frame that would be expected for the RETEC Team to complete the activities that will be conducted to assist the Agencies in developing a comprehensive work plan for a pre-design sediment characterization effort for the Lower Fox River. Implementation by other entities will necessitate a revision and/or addendum to this QAPP and/or SAP, and the project schedule as presented may not be attainable. This schedule also depends on unimpeded site access and that required review time deadlines of draft documents prepared during the course of the project are met.

1.4 Site History/Background Information

1.4.1 Lower Fox River

The Lower Fox River is defined as that 39-mile segment of the Lower Fox River beginning at the outlet of Lake Winnebago and terminating at the mouth of Green Bay. The river flows north and drains approximately 6,330 square miles, making it a primary tributary to Green Bay and a part of the Great Lakes system. Green Bay is a freshwater system approximately 120 miles long that drains into Lake Michigan, and is located on the state border between Wisconsin and Michigan along a northeast- to southwest-trending axis. Green Bay begins at the mouth of the Lower Fox River, extends north for approximately 193 kilometers (km) (120 miles), and has an average width of 37 km (23 miles). The Lower Fox River is by far the largest Green Bay tributary based on both discharge and drainage area. The Lower Fox River contributes approximately 42 percent of the total drainage into Green Bay (Bertrand, *et al*., 1976). Due to its volume, as well as the relatively higher concentration of industrial activity and pollutant load, the Lower Fox River is the tributary of greatest interest with respect to sediment and water quality in Green Bay. Over 95 percent of the PCB load and 70 percent of the suspended sediments flowing into the bay are derived from the Lower Fox River (WDNR, 1999; Smith, *et al*., 1988).

The Lower Fox River is the most industrialized river in Wisconsin, and has had reported water quality problems since the early 1900s. Beginning in the mid-1800s, forests were cleared for lumber and the cleared land was converted to agriculture. The runoff from farmlands increased the sediment and nutrient loads to the river and bay. The expanding paper industries and communities discharged increasing amounts of untreated sewage and industrial wastes into the river and, ultimately, the bay. The Lower Fox River received discharges from 15 pulp and/or paper mills, one electrical generating facility, and eight municipal wastewater treatment plants. Green Bay's ability to trap nutrients hastened its degradation under the increasing loads of biological oxygen-demanding wastes and suspended solids (Smith *et al*., 1988). Until the early 1970s, the extreme southern portion of Green Bay (including the 11 km [7 miles] of the Lower Fox River downstream of the De Pere dam) was a shallow (1- to 5-meter [3- to 16-foot] depth), eutrophic waterbody that received virtually all of its nutrient loadings from the Lower Fox River and the city of Green Bay. In the early 1970s, PCBs were discovered in sediments and water in the Lower Fox River. PCBs were also detected in many fish species and birds in the Lower Fox River and Green Bay. Between 190,000 and 375,000 kg (418,878 and 826,734 pounds) of PCBs have been released into the Lower Fox River over the period from 1957 to 1992 (WDNR, 1998). In 1977, the WDNR issued the first warnings regarding human consumption of trout, salmon, and carp principally due to

elevated levels of PCBs. Since 1977, WDNR has annually issued fish consumption advisories for most common species in the Lower Fox River and Green Bay. Additionally, waterfowl consumption advisory exists for mallard ducks taken between Lake Winnebago and the northeast limits of Kaukauna.

While, historically, the concerns on the Lower Fox River have largely centered on PCBs, other studies have identified additional chemicals that could pose risks to human health and ecological receptors on the Lower Fox River (Sullivan and Delfino, 1982). For example, Sullivan and Delfino (1982) found more than 100 chemicals in Lower Fox River sediments, water, and fish tissues. More recent estimates list up to 362 potentially toxic substances in the river and southern Green Bay (WDNR, 1993), including mercury, total PAHs, and ammonia. Other contaminants found in specific locations of the river and Green Bay include arsenic, chromium, copper, lead, zinc, 4,4'-dichlorodiphenyl trichloroethane (DDT), 4,4'-dichlorodiphenyl dichloroethylene (DDE), dieldrin, and pentachlorophenol (PCP). Presently, of the potentially toxic substances found, PCBs are considered to be the primary chemical of potential concern (RETEC, 1998a). Adverse effects associated with these substances can include altered benthic community structure and reproductive impairments in fish-eating birds.

Extensive evaluations of PCB contamination in sediment, fish, and wildlife have been conducted on the Lower Fox River and Green Bay by the WDNR, the USEPA, and the United States Fish and Wildlife Service (USFWS). These studies included measurement of concentrations in sediments, surface water, fish, and avian species; fate and transport modeling of PCBs; and evaluations of environmental impacts. Historic discharges from municipal, industrial, and agricultural sources in the Lower Fox River region have degraded sediment and water quality and adversely impacted the ecology of the river and bay. The Baseline Risk Assessment (BLRA) identified a list of chemicals of potential concern (COPCs) that included PCBs (total and Aroclors), dioxins/furans, DDT and its metabolites, dieldrin, and several metals (arsenic, lead, and mercury). The BLRA concluded that the chemicals of concern (PCBs, mercury, DDE) represented potential risks to human health and ecological receptors. PCBs in the Lower Fox River pose the major potential threat to human health and ecological receptors due to their tendency to sorb to sediments, persist in the environment, and bioaccumulate in aquatic organisms. Contaminated sediments acting as "sinks" for PCBs and other contaminants are also subject to physical and chemical processes that affect the overlying water column and adjoining water bodies in natural (uncontrolled) environments. For example, PCBs from sediment in the Lower Fox River are discharged into Green Bay at the mouth of the river through sediment transport and PCB dissolution in the water column.

1.4.2 Historical PCB Use and Discharges

During the 1950s, 60s, and 70s, many industries throughout the United States used and/or produced products that contained PCBs. PCBs include a class of 209 related chlorinated organic compounds that share similar chemical properties and structure. PCB use was widespread because these compounds are chemically very stable, have a high heat capacity, and do not easily degrade in water. PCBs were historically used in electrical equipment, hydraulic fluids, fire retardants, cutting oil, and a number of other commercial and industrial processes (Merck, 1989). In the early 1950s, National Cash Register (NCR) developed carbonless copy paper for office and business use. When struck by a typewriter or pressed with a pen, a coating of PCB emulsion on the paper released oils to produce the document copy. In 1954, local paper mills in the Lower Fox River valley began manufacturing carbonless copy paper and PCBs were released to the environment through process wastewaters and through the de-inking and recycling of waste carbonless copy paper. Due to rising health concerns about PCBs released to the environment, use of PCBs in the production of carbonless copy paper ceased in 1971. However, recycling of the carbonless copy paper may have continued for a short time thereafter. Monsanto, the primary manufacturer of PCBs in the United States, ceased distribution of PCBs for applications that were uncontained and open to the environment in 1977.

The companies/entities involved in the manufacturing and recycling of carbonless copy papers have been identified as the potentially responsible parties (PRPs) pursuant to the Comprehensive Environmental Response, Cleanup, and Liability Act (CERCLA). These companies formed the Lower Fox River Group (FRG), which collectively have undertaken studies evaluating PCB impacts to the river and bay system. The FRG includes the following seven companies (listed alphabetically): Appleton Papers, Inc.; Fort James Corporation; NCR Corporation; P.H. Glatfelter Company; Riverside Paper Corporation; U.S. Paper Mills Corporation; and Wisconsin Tissue Mills, Inc.

WDNR completed an evaluation of PCB discharges to the Lower Fox River beginning in the 1950s and coinciding with the production and recycling of carbonless copy paper. WDNR (1999) estimated that approximately 313,600 kg (691,370 pounds) of PCBs were released to the environment during this time, although the discharge estimates range from 126,450 kg to 399,450 kg (278,775 pounds to 880,640 pounds), based on the percentages of PCBs lost during production or recycling of carbonless copy paper. WDNR (1999) estimated that 98 percent of the total PCB released into the Lower Fox River had occurred by the end of 1971. Further, WDNR (1999) indicated that five facilities, including the Appleton Papers-Coating Mill, P.H. Glatfelter Company and associated Arrowhead Landfill, Fort James-Green Bay West

Mill (formerly Fort Howard), Wisconsin Tissue, and Appleton Papers-Locks Mill, contributed over 99 percent of the total PCBs discharged to the river.

Currently, PCBs are discharged into Green Bay at the mouth of the Lower Fox River through sediment transport and PCB dissolution in the water column. Sediments are the most significant source of PCBs entering the water column (Fitzgerald and Steuer, 1996), and over 95 percent of the PCB load into Green Bay is derived from the Lower Fox River (WDNR, 1999). Based on the data analyzed as part of this effort, approximately 70,000 kg (154,300 pounds) of PCBs have already escaped from the Lower Fox River into Green Bay.

1.4.3 Study Area Operable Units

To facilitate modeling activities and identification of specific points along the river, the Lower Fox River and Green Bay was divided into the following five Operable Units in sequential order going downstream:

- OU 1 Little Lake Butte des Morts
- OU 2 Appleton to Little Rapids
- OU 3 Little Rapids to De Pere, and
- OU 4 De Pere to Green Bay (also Green Bay Zone 1)
- OU 5 Green Bay (Green Bay Zone 2)

These five Operable Units were based on similar water depths, current velocities, contaminant concentrations and distribution, and dam/lock structures. These reach designations were used during the RI to streamline the evaluation and reporting of sediment, water, and biological tissue data. Specific sediment deposits were identified in the first three OUs (Little Lake Butte des Morts, Appleton to Little Rapids, and Little Rapids to De Pere). These deposits were labeled A through HH and POG. Deposits were originally designated based on physical attributes, then later the chemical nature, and the extent of each deposit was determined. The LFRPD is confined to Operable Units 1, 3 and 4. No characterization is proposed in Operable Units 2 or 5 given the RODs recommendations for Monitored Natural Recovery in these Operable Units. However, Deposit DD in OU 2 will be considered part of OU 3 and the near shore area of the Bay in OU 5 will be included as part of OU 4 as requested by WDNR. The OU geographical designations used throughout this QAPP and the SAP are described in the QAPP Sections below, and are pictured in Figure 3. Details of the existing conditions at each OU are contained in SAP Sections 1.1 – 1.4.

Operable Unit 1

For the LFRPD study, OU 1 is defined as extending from the outlet of Lake Winnebago to Appleton for a distance of approximately 10 km (6 mi), and includes sediment deposits A through H, and POG.

Operable Unit 3

For the LFRPD study, OU 3 is defined as extending from the Little Rapids dam to the De Pere dam for a distance of approximately 9.7 km (7 mi), and includes sediment Deposit DD in OU 2 and Deposits EE through HH. These deposits form a nearly continuous layer of soft sediment that extends for approximately 8.5 km (5 mi) upstream of the De Pere dam. Sediment accumulation in this OU extends over a long distance and large area. The four sediment deposits in this OU (deposits EE through HH) contain 1,250 kg of PCBs in approximately 1.71 million m^3 (3 million cy) of sediment with concentrations greater than 50 µg/kg PCB. The four deposits in this reach are essentially a single sediment unit covering about 266 hectares (657 acres). Sediment thickness ranges up to 2.3 meters (7.5 feet) thick in select areas, especially near the De Pere dam. The highest detected total PCB concentration in sediment was 54,000 µg/kg (average 6,292 µg/kg). Concentrations exceeding 5,000 µg/kg exist at the southernmost limit to Deposit EE, and at the northernmost part of the reach behind the De Pere dam. Almost all of the PCBs are contained in the upper 100 cm (3.28 feet) of sediments, with 535 kg (1,180 pounds) contained in the upper 0 to 30 cm (0 to 1 foot).

In addition, Deposit DD (located in OU 2) will be removed as part of the OU 3 remediation. Covering a total area of approximately 37 acres, Deposit DD contains an estimated PCB mass of 31 kg and a contaminated sediment volume of approximately 9,000 cy.

The OU 3 remedy identified addresses 595,000 cy of contaminated sediment containing approximately 1,140 kg of PCBs (including Deposit DD).

Operable Unit 4

For the LFRPD study, OU 4 is defined as extending about 11.3 km (7 mi) from the De Pere dam to the mouth of the Lower Fox River and will include sediment in the nearshore area of the mouth into the Bay in OU 5. Due to the presence of a large and continuous layer of soft sediment between the dam and the river mouth, this area has been divided into 96 SMUs (numbered 20 through 115) and 16 water column segments (6 SMUs per segment). The SMUs and water column segments were initially established for computer modeling studies. This OU is also referred to as Green Bay Zone 1 for certain modeling activities. This OU contains the largest volume and aerial extent of impacted sediments in the Lower Fox River. Ninety-one (91) percent of the PCB mass for the entire river is present in this reach. The 96 SMUs in this reach contain 25,984 kg (57,285 pounds) of PCBs in over 5.5 million m3 (7.2 million cy) of sediments with concentrations greater than 50 µg/kg PCB. Almost the entire sediment bottom contains soft sediment covering about 524 hectares (1,295 acres) and ranging in thickness up to 4 meters (13 feet). The

highest detected total PCB concentration in sediment was 710,000 µg/kg (average 21,722 µg/kg) before the completion of the Sediment Management Unit (SMU) 56/57 demonstration project. Approximately 636 kg (1,400 pounds) of PCB and 31,000 m3 (40,550 cy) of sediment were removed from SMUs 56–61 during the SMU 56/57 sediment remediation demonstration project. Additional sediment and PCBs were removed from SMU 56/57 in August 2000. Excluding SMUs 56–61, six SMU groups (SMUs 20–25, 32–37, 38–43, 62–67, 78–73, and 80–85) contain almost 11,000 kg (24,250 pounds) of PCBs, or about 37 percent of the total mass in the Lower Fox River. These SMU groups also exhibit the highest PCB concentrations or greatest PCB mass to sediment volume ratios in the river. The mass of PCBs increases significantly with depth. Approximately 16,150 kg (35,530 pounds) of PCBs, or about 55 percent of the total PCB mass in the Lower Fox River, occurs in the upper 100 cm (3.28 feet) of sediment. Approximately 10,600 kg (23,370 pounds) of PCBs (36 percent of the PCBs in the river) are buried below 100 cm (3.28 feet). PCBs are fairly evenly distributed in the surface sediments within this OU. Of the 5,210,000 m2 of sediment surface within this OU, 4,500,000 m2 (87 percent) have PCB concentrations greater than 1,000 µg/kg.

1.4.4 LFRPD Study Areas

The LFRPD will essentially culminate in the preparation of a Basis of Design Report (BODR) and construction bid documents for basemaps of OUs 1, 3 and 4. The BODR must encompass the information necessary to support development of final engineering design, construction bid documents, contractor selection, and implementation. This is consistent with the process used for both pilot dredging projects at Deposit N and SMU 56/57. Recognizing that the existing data is either insufficient or non-existent to complete a BODR, additional field investigations, bench-scale studies, and geotechnical evaluations of sediments are necessary. These data will provide the basis to engineer, select and properly size capping, dredging, dewatering, water treatment and disposal technologies with confidence.

The data collected as part of the LFRPD are necessary to:

- Achieve WDNR and USEPA's stated goal of implementing remedial actions in Operable Unit 1 in 2004
- Provide WDNR and USEPA a greater level of certainty in the volumes of material to be addressed for use as a basis in settlement negotiations
- Increase the confidence in describing existing site conditions, thus reducing the potential for "changed conditions" claims by remediation contractors

- Address data needs for each major component of the remedy described in the OUs 3, 4, and 5 ROD.

The basis for completing the remedy is achieving removal to a pre-defined elevation, dewatering and disposal in a licensed landfill. The LFRPD must also provide the data that is needed to make final engineering decisions and perform final design of the selected site remedy. RETEC has been performing preliminary engineering work for the WDNR as part of its Detailed Evaluation of Alternatives. As a result, the data needs for final engineering on a range of potential site remedies, from capping to mechanical dewatering to landfill disposal have been identified. A list of data needs, and the recommended calculations, tests and measurements to fill them, is contained in Table 1. Each data need is tied to one or more specific remedy components, or remedial technologies, and the way in which the data will be used during the engineering process is described. This testing plan also describes the basis for collecting an appropriate number and type of samples. Unlike the delineation phase of the SAP, some of the engineering data must be generated on a non-random, or focused, basis. For example, samples submitted for settling tests and dewatering tests must reflect the range of grain size distributions that are likely to be encountered across the millions of cubic yards of material. A number of representative samples from among an initial, broad characterization of each OU will be used for the collection of engineering data.

The chemical and physical characterization data for OU1 portion of the LFRPD are implemented by the PRPs, and are independent of this QAPP and SAP.

1.5 Data Quality Objectives (DQOs)

Data Quality Objectives (DQOs) are qualitative and quantitative statements that clearly define the objectives of the project, define the most appropriate type of data, determine the appropriate procedures for data collection, and specify acceptable decision error limits that establish the quantity and quality of data needed for decision making. The technical planning team developed project-specific DQOs during the initial project scooping stages in accordance with USEPA's Guidance for the Data Quality Objectives Process (EPA QA/G-4, 1994). During the systematic planning process, the scoping team identified the analytes, action levels, sample media, number of samples, and acceptance limits of accuracy and precision. Based on the project DQOs, the team established requirements for specific analytical methods, analyte lists, QC procedures, detection/RLs, and QC acceptance criteria for the project. Documented in this QAPP are these requirements. Proposed additions or changes to the requirements in the approved QAPP will be documented in a QAPP Addendum and submitted for review and approval.

The DQO Process aids in the definition of the type, quality and quantity of data needed for the pre-design engineering decisions and is the infrastructure of the QAPP and SAP. The results of the seven-step DQO Process for the LFRPD are presented in Sections 1.5.1-1.5.7.

1.5.1 Problem Statement

An accurate delineation of the 1 part per million PCB dredge elevation, referenced to both horizontal and vertical control datum along with adequate characterization of physical and geotechnical properties of the sediment are necessary to develop the final remedial design and bid documents for the four Lower Fox River Operable Units.

1.5.2 Decision Identification

Is the historical data collected of sufficient quality and quantity to aid in accurately and precisely delineating the 1 ppm PCB dredge elevation?

Is the historical data collected of sufficient quality and quantity to aid in accurately and precisely delineating the 50 ppm PCB dredge elevation?

If the historical data collected is not of sufficient quality or quantity, what sampling locations and sample collection techniques are needed to yield the refined estimate?

What is the location of the 1 ppm PCB dredge elevation and are individual data points measured to within $\pm$ 5 cm vertical (z) and < 1 m horizontal (x,y)?

At what locations and depth(s) do Lower Fox River Operable Unit sediments exceed 1 ppm total PCBs on a dry weight basis?

Are the physical and geotechnical characteristics of the sediment adequately characterized to properly develop and successful implementation of a final remedial design?

Are the dredge volumes sufficiently characterized to accurately determine volumes of sediments exceeding 1 ppm and associated costs for dredging?

1.5.3 Decision Inputs

EXISTING DATA: Unfortunately, the existing data from the site are not adequate to properly engineer and design the remedial components for several reasons including:

- Almost all of the previous data is of insufficient quality for accurate delineation of the 1 ppm dredge elevation because previous data collections:

- Did not reference core segments or the mudline to a benchmarked elevation (z)
- Used inconsistent methods to collect sediment cores
- Did not record or had highly variable penetration: recovery ratios
- Used different location methods/technologies and therefore accuracies to geo-locate the core station in the horizontal plane (x,y)
- Used widely inconsistent sample intervals (2 cm to 2 feet)

- The historical dataset contains too little data relating to the physical and geotechnical characteristics of the sediment for proper design of capping, removal or partial removal and cap alternatives
- There are no data to address physical and geotechnical information necessary to properly design and construct upland staging and processing facilities
- Dewatering and bench-scale treatability testing is limited to samples from the location of the two pilot dredging projects (SMU 56/57, Deposit N), which may not be characteristic of the entire site

NEED NEW DATA: Total PCB results (dry weight basis) on all samples collected using a quantitative and semi-qualitative PCB screening method with an acceptable RL sufficiently below the Action Limit of 1 ppm and an insignificant false negative rate for selection of samples for definitive analysis by Fox River PCB method which incorporates the analytical USEPA Method 8082 with air-drying, homogenizing, and cleanup options in addition to the analytical procedure.

NEED NEW DATA: Validated vertical and horizontal total PCB concentrations in samples using Fox River PCB method with an acceptable and verifiable RL of < 1 ppm.

NEED NEW DATA: Sub-bottom profile to identify areas of soft sediments.

NEED NEW DATA: Map of sediment depth referenced to North American Vertical Datum (NAVD) (88) and sediment location referenced to Wisconsin Transverse Mercator (WTM) North American Datum (NAD) 83/91.

NEED NEW DATA: Validated geotechnical data (such as grain size, in-situ density, specific gravity, Atterberg limits, organic content, consolidation, shear strength, moisture content, percent solids, bulk density, particle size) for evaluation of upland staging areas, capping alternative, dewatering and treatability testing.

NEED NEW DATA: Validated leachate test results for passive dewatering basin liner design.

1.5.4 Investigation Boundaries

Site maps showing the investigation boundary of each OU are contained in the SAP as Figures 1-1, 1-8 and 2-15. The boundary of OU 1, and OUs 3 and 4 have previously been defined in the RODs. The investigation boundary will not necessarily be just the OU boundary and will include Deposit DD in OU 2 as part of OU 3, and will include a 1,500-feet radius of work into Green Bay (part of OU 5) as part of OU 4 as defined in the ROD for OUs 3, 4, and 5. Field operations will likely be limited by weather and/or season.

1.5.5 WDNR and USEPA Decision Process

If the sediment sample total PCB concentration does not exceed the screening method RL (screening method RL must be as close to the 1 ppm Action Limit as possible, preferably a factor of 2-5 below it), it may be analyzed by the Fox River PCB method.

If the sediment sample total PCB concentration slightly exceeds (i.e., by a factor of 5) the screening method RL, then it will be selected for confirmatory analysis by the Fox River PCB method. Initially, all samples with screening method PCB concentrations in the region of RL to ~ 5 X RL (0.5 – 2.0 ppm) will also be analyzed by the Fox River method and as more precision and accuracy data are collected, and the confidence limit around the RL refined, this frequency will likely be reduced.

If the sediment sample total PCB concentration significantly exceeds (i.e., by a factor of 5) the screening method RL, then it may be selected for confirmatory analysis by the Fox River PCB method.

If the total PCB concentration of one sediment sample of a duplicate/co-located pair exceeds the screening method RL and the other does not, then it will be analyzed by the Fox River PCB method.

If the correlation between the screening method total PCB concentrations and the Fox River PCB method concentrations is acceptable ($r^2 > 0.80$), the screening method concentration will be considered definitive and comparable.

If an additional laboratory is used for screening sediment samples for PCBs, geotechnical analyses or Fox River PCB method analysis, each laboratory must analyze a subset of site samples and the correlation between the primary laboratory and the second laboratory results must be acceptable ($r^2 > 0.80$) before the additional laboratory can be considered to provide data of acceptable comparability.

1.5.6 Specifying Limits of Decision Errors

The majority of the potential decision errors are typically associated with field sample variability and sample collection procedures. Analytical error is usually a much smaller portion of the total error associated with an environmental measurement, however the analytical data must be reported by the laboratory at low enough levels that will allow comparison to the existing standards as presented in Table 2.

The WDNR and USEPA have specified limits of decision errors that are indicative of how much uncertainty will be tolerated in the decision(s). Locational information collected during activities, which support the delineation of the 1ppm dredge prisim, must have accuracies of $\leq$ 1m in the horizontal and $\leq$ 5 cm in the vertical. In addition, the surface-weighted average concentration of PCBs left in the river must be less than 1 ppm. Biased, rather than statistical sampling will be done during the pre-design characterization of each OU to enable more sample collection in locations with known high matrix variability. The specific number of samples, sampling density and rationale (i.e., number of cores per acre and depth intervals in the core for chemical analysis) is presented in SAP Section 2.3.

As analysis of samples by the PCB screening method progresses, precision, accuracy and comparability data will be collected. The decision error associated with the screening method can then be calculated and the decision rules for analysis by the Fox River PCB method can be revisited. The goal is for the screening method to be biased high with an insignificant false negative rate and a RL of less than or equal to 0.5 ppm. Based on the results of the screening method study in Appendix C, the RL for the screening method is 0.5 ppm.

1.5.7 Optimizing the Design

Cores will be of sufficient diameter to allow for at least two intact "mini" cores to be sub-sampled from them for geotechnical and PCB analysis to reduce additional collection for field replicate analysis or Matrix Spike/Matrix Spike Duplicate (MS/MSD) analysis.

Cores will be collected in a tiered approach. In Phase 1 collection, soft sediment areas will randomly sampled at a rate of one core per acre and

clusters of several cores will be collected at some of these locations with historically variable PCB concentrations. In Phase 2 collection, areas of great variability in either PCB concentration or physical parameters will have 3-4 more cores per acre collected. Areas of low variability will have fewer, or no additional cores collected in Phase 2. Ten-centimeter (cm) intervals will be subsampled in the field from each core and sent for analysis for total PCBs and geotechnical parameters. The estimated number of samples for total PCBs and geotechnical analysis for each OU are presented in SAP Table 2-4.

Up to 5 percent of the samples that do not exceed an acceptable screening method RL will be analyzed by the Fox River PCB method.

Up to 5 percent of the sediment samples that exceed an acceptable screening method RL will be analyzed by the Fox River PCB method.

Up to 100 percent of the sediment samples that are within the range of 1 ppm $\pm$ screening method RL (0.5 – 1.5 ppm) will be analyzed by the Fox River PCB method

Side scan sonar survey (or sub-bottom) will be used to confirm presence of soft sediment targeted for sample collection in Phase 1.

Physical, chemical and geotechnical characterizations associated with a capping remedy will only be conducted in areas where a capping remedy can be implemented based on criteria presented in the FS, PRAP and/or ROD.

1.6 Project Quality Assurance Objectives for Measurement

The overall QA objective for the project is to develop and implement procedures for field sampling, COC, laboratory analysis, and reporting that result in data of known and usable quality. Specific procedures for sampling, COC, laboratory instrument calibration, laboratory analysis, reporting data, internal quality control, audits, maintenance of field equipment, and corrective action are described in other sections of this QAPP. This section addresses the objectives of usable analytical data quality: precision, accuracy, completeness, representativeness, comparability and sensitivity.

To measure the data quality indicators field co-located samples, lab duplicates, matrix spike, and matrix spike duplicate, samples will be analyzed as appropriate to the analytical method and sample matrix. A description of these quality control samples is contained in Sections 1.6.1 and 1.6.2. Table 3 summarizes the frequency and type of the QC samples by analyte and media.

1.6.1 Precision

Precision measures the reproducibility of measurements. It is defined as the degree of mutual agreement among independent measurements as the result of repeated application of the same process under similar conditions. Analytical precision is the measurement of the variability associated with duplicate or replicate analyses. Total precision is the measurement of the variability associated with the entire sampling and analysis process. Total precision is determined by analysis of duplicate or replicate field samples and measures variability introduced by both the laboratory and field operations. Table 3 provides the frequency of and acceptance criteria for precision for the LFRPD analyses.

The principal measurement of precision will be relative percent difference (RPD) obtained from duplicate sample pairs and will be calculated as:

$$RPD = \frac{(C_1 - C_2)x100\%}{(C_1 + C_2)/2}$$

where:

C1 = larger of two observed values

C2 = smaller of two observed values.

Field Precision Objectives

Field duplicate samples for sediment will be collected for the LFRPD as co-located cores. Field duplicates will be collected at a frequency of no less than 5 percent of the number of field samples collected and of each matrix sampled. Each duplicate sample will be collected for the suite of analyses designated for the original sample. To the extent practical, field duplicates will be coded and labeled such that data validation staff can readily identify duplicates but the laboratory cannot.

Laboratory Precision Objectives

Laboratory duplicates including matrix spikes (MS) and matrix spike duplicates (MSD) will be prepared and analyzed for each matrix submitted to the laboratory, as prescribed in the approved method, and at a frequency of no less than 5 percent of the number of project samples analyzed. Laboratory duplicates will be analyzed concurrently with the associated project samples.

1.6.2 Accuracy

Accuracy is the degree of conformity of a measurement to a true value or a known standard and reflects the total error associated with a measurement. Accuracy in analysis is a function of the calibration method. Measurement

accuracy is determined by analyzing a standard of known concentration and comparing the measured result to the true concentration.

Field Accuracy Objectives

Accuracy in the field is assured through controlling cross-contamination during sample collection and handling, adherence to sample handling and shipping procedures and adequate preservation. No trip or field blanks are directly applicable to sediment sample collection and their data reporting units of mg/kg dry weight.

Laboratory Accuracy Objectives

Continuing calibration verifications (CCV), laboratory control samples (LCS), matrix spike (MS) samples, and surrogate spike samples are examples of QC procedures that are used to measure analytical accuracy. To the extent practical, MS/MSD, SRMs and LCSs should include all target compounds or analytes for the given analysis. Table 3 provides the frequency of and acceptance criteria for accuracy for the LFRPD analyses.

Accuracy will be expressed and calculated as the percent recovery of a known concentration of analyte added to a field sample as a surrogate spike or MS/MSD. Recovery from spiked samples will be calculated as:

$$\%R = 100\% x \frac{(S - U)}{C_{sa}}$$

where:

%R = percent recovery

S = measured concentration in spiked aliquot

U = measured concentration in unspiked aliquot, and
C_{sa} = actual concentration of spike added.

Only project samples will be used for MS/MSD. Blanks will not be used for the preparation of MS/MSDs. For each shipment of aqueous leachate samples sent to the laboratory, sufficient sample volume will be collected and provided with the shipped samples to be used for preparation of the MS/MSD. This sample will include sufficient volume such that one re-extraction/reanalysis of the MS/MSD pair can be performed. Alternatively, a sample delivery group system may be established, and sufficient volume for an MS/MSD need only be collected once per sample delivery group. No additional sample volume is needed for MS/MSD analysis for sediments.

For situations where a standard reference material (SRM) or laboratory control standard (LCS) is used instead of or in addition to matrix spikes:

$$\%R = 100\% \frac{C_m}{C_{srm}}$$

where:

%R = percent recovery

C_m = measured concentration of SRM or LCS

C_{srm} = actual concentration of SRM or LCS

1.6.3 Representativeness

Representativeness is a qualitative term that describes the extent to which a sampling design adequately represents the environmental conditions of the OU. It also reflects the ability of the sample team to collect samples and laboratory personnel to analyze those samples in such manner that the data generated accurately and precisely represents the conditions of the OU.

Measures to Ensure Representativeness of Field Data

Representativeness is typically achieved by establishing the level of allowable uncertainty in the data and then statistically determining the number of samples needed to characterize the population through the DQO process. For this project, representativeness will be achieved by ensuring that sampling locations are properly selected and adequate core recovery is achieved at each location. Representativeness is dependent upon the proper design of the sampling program and will be accomplished by ensuring that this QAPP, the SAP and the project SOPs are followed. The QA goal is to have all samples and measurements representative of the media sampled.

Measures to Ensure Representativeness of Laboratory Data

Representativeness of laboratory data cannot be quantified. However, adherence to the prescribed analytical methods and procedures, including holding times and preservation temperature will aid in ensuring representativeness. In addition, the laboratory will adequately homogenize sediment samples to provide a representative subsample for analysis. The analysis of lab blanks will assess any contribution of lab background to the sample and analysis of lab duplicates will measure the variability of the sample matrix and homogenization technique.

1.6.4 Completeness

Completeness is defined as the measure of the quantity of valid data obtained from a measurement system compared to the quantity that was expected under normal conditions. While a completeness goal of 100 percent is desirable, an overall completeness goal of 90 percent may be realistically achieved under normal field sampling and laboratory analysis conditions.

Field Completeness Objectives

The field-sampling team will take measures to generate valid data in the field. However, some samples are likely to be lost, leak during handling and transit, or core recovery was not adequate to provide enough sample volume for analysis. Therefore, field completeness goals for this project will be 90 percent of all the samples collected in the field.

Laboratory Completeness Objectives

Laboratory completeness is a measure of the quantity of valid results obtained from all the analyses completed for the project. The laboratory completeness goal is 90 percent of all the samples analyzed.

The combined impact of field and laboratory completeness on the delineation of the 1 ppm dredge prism will be evaluated. This evaluation will consist of reviewing results from cores with missing segments to determine if PCB results> 1ppm are present in lower segments. If this condition is true the missing data will have no consequence on the delineation. If this condition is false, the missing segments will be plotted on a preliminary 1 ppm PCB elevation interpolation to determine the sediment volume which might be added to the prism. A determination will be made on an individual case basis if correlation, such as additional core collection, is warranted.

1.6.5 Comparability

The confidence with which one data set can be compared to another is a measure of comparability. The ability to compare data sets is particularly critical for the LFRPD as the data from these investigations will likely be compared to the historical data for determining trends or identifying unusual changes in the sediment conditions.

Measures to Ensure Comparability of Field Data

Ensuring that this QAPP, SAP and field collection SOPs are adhered to and that all samples are properly handled and analyzed will satisfy the comparability of field data. In addition, efforts will be made to have all sampling completed in a consistent manner by the same sampling team.

Measures to Ensure Comparability of Laboratory Data

Analytical data are comparable when the data are collected and preserved in the same manner followed by analysis with the same standard method, RLs and results units (i.e., mg/kg dry weight). Data comparability is limited to data from the same environmental media. Analytical method quality specifications have been established to help ensure the data will produce comparable results. Table 2 summarizes the laboratory RLs and units to be used.

The single most important requirement to ensure PCB data comparability is for all laboratories generating PCB results to follow the USEPA reference method 8082 modified for the Lower Fox River sediments. These modifications include air-drying the sediment and then grinding the air-dried sample with a mortar and pestle prior to extraction. USEPA Method 3660A is used for sulfur removal, USEPA Method 3620B for florisil cleanup and USEPA Method 3665B for acid clean up. Soxhlet extraction by USEPA method 3540 is necessary to provide a rigorous enough extraction of PCBs from the matrix. En Chem has evaluated USEPA Method 3541 with the Soxtherm® apparatus and it provides for PCB extraction comparable to Soxhlet in 4 hours instead of 16 hours. Comparability data for the Soxhlet and Soxtherm extraction techniques in Lower Fox sediments are included in Appendix C.

1.6.6 Sensitivity

Sensitivity will be expressed in terms of detection and quantitation limits for each type of measurement/analysis. Detection/quantitation requirements for each analyte/method/matrix are presented in Table 2. These detection and quantitation limit requirements are listed along with those actually achieved by the analytical laboratory to verify that they are attainable with the specified methodology and instrumentation. The detection limit for the LFRPD will be expressed as the Method Detection Limit (MDL). MDL is defined as follows:

$$MDL = t\,(n-1,\ 1-a=0.99) \times S$$

where :

MDL = Method Detection Limit

S = standard deviation of the replicate analyses

t (n-1, 1-a=0.99) = Students' t-value for a one-sided 99 percent confidence level and a standard deviation estimate with n-1 degrees of freedom.

Where required, method detection studies will be performed in accordance with 40 CFR 136, Appendix B, if the current MDL study is not deemed recent enough by the WDNR QA Manager. All laboratories will notify the WDNR QA Manager prior to project sample analysis, if the laboratory anticipates or experiences any difficulties in achieving the detection/quantitation limits specified in this QAPP.

To be confident in the quantitation of the analyte, the measured concentration must not only exceed the instrument/MDL but also exceed a quantitation limit. The quantitation limit for the LFRPD will be expressed as the RL. The RL in Wisconsin is calculated as the MDL multiplied by a safety factor multiplier of 3.3. Values reported above the MDL, but below the RL would be reported by the laboratories as estimated with a J qualifier to indicate that the value is imprecise from its location in this region of quantitation.

Matrix effects should be considered in assessing the laboratory's compliance with sensitivity specifications of MDL and RL. The laboratory will provide a detailed discussion of all failures to meet sensitivity specifications in the data package narrative. If a sample dilution results in non-detected values for analytes that had been detected in the original analysis, the results of the original run and the dilution will be reported with the appropriate notations in the data narrative.

1.7 Laboratory Screening

Design level data needs will require that many samples to be analyzed for total PCBs. Data needs require a sufficient density of samples at a fine resolution. Because of the large number of samples, a screening method that provides reliable results in a timely manner on a large number of samples will significantly reduce the cost of analysis and the timeframe for decision-making. It is imperative that a screening method be reliable around the action level of 1.0 mg/kg total PCBs. The immunoassay technique as described in USEPA Method 4020 is proposed to reduce the number of samples that need further characterization by USEPA Method 8082 (modified for Lower Fox River sediment matrix).

1.7.1 Hybrizyme Immunoassay Methods

The Hybrizyme PCB Immunoassay kit is proposed for screening Lower Fox River sediments. It is a third-generation immunoassay technique. The original PCB immunoassays used a non-specific, color development reaction to determine the concentration of PCBs in a sample. The Hybrizyme procedure differs in that it uses Aroclor-specific development of fluorescence to determine the PCB concentration. Using the Hybrizyme method with the fluorescence endpoint helps to eliminate possible interferences present, and

results in more accurate determinations of PCB concentrations than do immunoassays using the colorimetric endpoint.

The Hybrizyme protocol involves drying a five-gram (dry weight basis) sediment sample by adding sodium sulfate, followed by an extraction with methanol. An aliquot of the sample extract is added to a microtiter plate well and incubated with a PCB antibody. Any PCB present is bound to the PCB antibody. A second antibody attached to the microtiter plate wells binds with and traps the antibody-PCB complex. The microtiter plate wells are washed to remove matrix interferences that may be present in the sample extract. A Europium-labeled PCB compound (PCB Tracer) is added and allowed to bind to any PCB antibody sites that are empty. A second wash step removes any unbound PCB tracer. Enhancement solution is added and forms a highly fluorescent chelate with the europium ions. The amount of fluorescence produced is inversely proportional to the concentration of PCB in the sample. Each extract is analyzed in duplicate. Total PCB concentration is determined by comparing the sample fluorescence to that of a series of Aroclor standards. The Hybrizyme immunoassay calculates results with the use of either an average calibration curve of stored values that can be regularly updated or a daily calibration curve.

Hybrizyme employs two different protocols for analyzing PCBs, namely PCB and PCB-XL. The PCB protocol was designed for soils and the PCB-XL protocol for tissues. The sensitivity can be adjusted by the selection of the protocol used, and/or varying the amount of sample extract that is used in the immunoassay. The PCB-XL protocol has an Aroclor 1242 RL of 0.05mg/kg on a dry weight basis, however, because of a limited linear range of approximately an order of magnitude, a reduced volume of extract was used in this study. The Aroclor 1242 working range for the PCB-XL protocol, with the reduced extract volume, is approximately 0.4-3.5 mg/kg. The PCB protocol calibration working range is approximately 0.4-6.0 mg/kg.

1.7.2 Method Validation Study

En Chem and RETEC designed a method validation study to assess the comparability of the Hybrizyme Immunoassay (USEPA Method 4020) test for PCBs to USEPA Method 8082 modified for the Lower Fox River sediment matrix. The report containing the results of the method validation study, titled ”Screening Method Validation Study Results”, is contained in Appendix C. The goal of the study was to determine whether the Hybrizyme Immunoassay would yield reliable total PCB results in a specific concentration region. If reliable and comparable results were obtained using the Hybrizyme method, then this method could be used as a means of screening large numbers of sediment samples with only a portion of them requiring full analysis by USEPA Method 8082. This would allow for the analysis of a large number of

samples in a short period of time at a reduced cost, thus maintaining project schedules and budgets.

In tandem with this study, En Chem also compared the use of the traditional extraction by USEPA SW 846 Method 3540C (Soxhlet) and the automated Soxhlet extraction by USEPA SW 846 Method 3541 using the Soxthermä extraction system (Soxtherm) on Lower Fox River sediments. The extraction method used to date on the Lower Fox River sediment matrix has been the USEPA Method 3540C. USEPA Method 3541 is automated and provides for a much higher throughput of samples in the lab over the traditional system, and utilizes lesser solvent volume in the extraction process. Again, this helps address maintaining project schedules and budgets. The goal of this portion of the study was to assess the comparability of the USEPA Method 8082 (as modified for Lower Fox River sediments) results between sediments prepared by the Soxhlet and Soxtherm extraction methods. Hybrizyme data was also compared to the Soxtherm data.

A variety of conditions were tested and statistical comparisons were made across all concentrations of the study sediments, and specifically around the LFRPD action level of 1.0 mg/kg total PCBs. Total PCBs were measured as Aroclor 1242. Aroclor 1242 is the primary Aroclor found in Lower Fox River sediments, however 1254 and 1260 are also present in some areas of the Lower Fox. As the Hybrizyme test uses a single Aroclor for the calibration curve, Aroclor 1242 was selected for calibration in the method validation study. USEPA Method 8082 modified for the Lower Fox River sediment matrix with Soxhlet extraction was used as the “standard” for comparison of the Hybrizyme Immunoassay and Soxtherm extraction results.

The statistical analysis of the different study conditions was conducted through the SPSS version 11.5 software package. Three different methods were used to evaluate the methods. The matched pair t-test involved each Soxhlet concentration with its matched data generated by Soxtherm, PCB and PCB-XL methods. The second method involved using regression analysis to determine the correlation coefficient of the line and the line equation for each data pair. The third method was visual examination of scatter plots generated from the matched pair data. Criteria for selection of which screening method protocol should be used included: less scatter of data around the decision point, greater correlation by t-test and regression analysis, and more consistency in response to Aroclors.

The data in Appendix C show that both Soxtherm and the Hybrizyme PCB method perform well on Lower Fox River sediments and would be effective means of analysis of these sediments as well as being cost and time saving measures for the LFRPD.

1.8 Documentation and Records

Project documents and records will be prepared or generated, reviewed, approved, and controlled as prescribed in the WDNR Quality Management Plan (QMP) and in accordance with USEPA direction. Electronic information (field observation data, including field parameter results, sediment core processing logs, photographs, laboratory electronic data deliverable (EDD), sediment core log, bathymetric XYZ data, bathymetric and side scan sonar interpretation, bathymetric and side scan sonar annotated printout, geographic information system (GIS) metadata, technical system audits (TSAs), reports, memos, etc.) transmitted to WDNR and USEPA will comply with the requirements in Section 2.8. The types of data collected are included in Section 2.8, which describes the project data management system, and details of deliverable formats of data are described in Section 4.1.3. RETEC will use select forms and documents for recording information during the study. Records to be used for project documentation include field forms, field books, laboratory reports, validation reports, and COC forms. The WDNR will retain the original copy of the records generated during LFRPD investigation activities for 5 years following the completion of this project. At a minimum, the draft and final editions of the pre-design characterization report, will include the following:

- Text describing field-sampling methodologies, analytical results, conclusions, and recommendations
- Figures showing OU location, OU boundaries, sampling locations, and summaries of impacted areas
- Tables comparing all laboratory data to the applicable standards
- Tables summarizing QA/QC analytical results
- Complete laboratory data reports, including copies of all COC records
- Data assessment section that discusses and compares overall field duplicate precision achieved as measured from co-located core samples collected for OUs 3 and 4

1.8.1 Field Notebooks

Field notes for sampling and measurement activities will be recorded using indelible black or blue ink in permanently bound notebooks with numbered pages. The person recording the notes will sign and date the bottom of every page in the field notebook. Changes will be crossed out with a single line so that the original text remains legible; the change will be initialed and dated.

Unused portions of logbook pages will be crossed out, signed, and dated by the assigned individual at the end of each workday.

The field notes will include the following information, as appropriate for each task:

- Location, date, and time
- Personnel performing the activity
- Type of PPE used
- Weather conditions
- The numerical value and units of each measurement
- The identity and calibration results for each item of field equipment used
- Sample type and sample collection method
- Unique sample numbers
- Depth(s) from which the sample was collected
- Description of the sample (e.g., color, odor, clarity)
- Identification of conditions that might affect the representativeness of the sample.

Field notebooks will be labeled with the project name, the name of the individual to whom the notebook has been assigned, and sequential notebook number. Upon project closeout, used field notebooks will be archived with the LFRPD project file.

1.8.2 Field Forms

Additional information may be recorded on separate field forms and referenced in the field notebook. All required forms, instructions for completion, and persons responsible for completing and archiving each form are provided in SAP Section 3 and SAP Appendix A. All forms MUST include the project name, OU, date and time, sample location and sample number(s) and name/signature of the person completing the form. Examples of standardized field forms that will be used on this project include the following:

- Core Log (attached in Appendix E)
- Coring Log (attached in Appendix E)
- Sample Control Log (attached in Appendix E)
- Chain-of-custody form (attached in Appendix E)
- Bathymetric and Side Scan Sonar Survey Log (attached in Appendix E)

1.8.3 Photographs

Photographs will be taken to document field activities when required. In accordance with the USEPA National Enforcement Investigation Center (NEIC) Multi-Media Investigation Manual, March 1992, the following information will be recorded in the field notebook as the photographs are taken:

- Name of photographer
- Date, time, location, and direction the photograph was taken
- Description of the photograph
- Aperture setting and shutter speed
- Special lenses, films, or other image enhancing techniques
- Reason for taking the photograph
- Sequential number of the photograph and the film roll number

After the photograph is developed, the information recorded in the field notebook will be transferred to the back of each picture. Digital photograph files will be downloaded from the camera to the LFRPD directory on the RETEC server and the information listed above linked to each photograph.

1.8.4 Analytical Data Reports

A hard copy report will be signed by the laboratory director or his/her designee and include a narrative about the analyses, original completed COC forms, and any other documentation received with the samples. The laboratory will also include a summary of the calibration data and laboratory QC data, and raw data (e.g., instrument printouts and manual records). The laboratory will provide an electronic copy of the data, which will follow the EDD format and requirements contained in Section 2.8 of this QAPP and Appendix F.

At a minimum, the hard copy report will include the following elements:

- Dates of sample receipt, preparation, and analysis
- Condition of samples upon receipt
- Sample preparation and analysis procedures
- Problems encountered during sample handling, storage, preparation, or analysis, and subsequent corrective and preventive actions
- Deviations from approved SOPs
- Results in dry weight units, along with percent solids determinations on "as received" and air dried samples
- Discussion of resulting data quality in a case narrative

1.9 Investigation-Derived Waste

Investigation-Derived Waste (IDW) generated in the field will be managed as prescribed in SAP Section 2.10. Unless otherwise required by contract agreement, the laboratories will be responsible for the proper disposal of all analyzed sample material and extracts. Left over unanalyzed sample material can be added to the field IDW.

2 Data Generation And Acquisition

This section describes the measurement system design and implementation. It provides requirements and procedures for sampling design and methodology, sample handling and custody, analytical methodology and acceptance criteria, equipment and material control, and data management.

2.1 Sampling Process Design

The purpose of the sampling is to collect a sufficient number of sediment samples in each OU to accurately characterize the dredge prism footprint and the sediment characteristics for the design of the remedial alternatives. Sampling locations, analytical parameters, and number of samples are contained in the SAP Section 2.3, SAP Figures 1-1 through 1-4, SAP Table 2-4. Laboratory analysis of the samples will include the following parameters:

- All sediment samples: PCBs as Aroclors, percent solids (as received and air dried), total organic carbon (TOC)
  - Selected sediment samples from each OU: grain size, bulk unit weight, percent solids, compressive strength, triaxial compression by American Society for Testing and Materials (ASTM) methods in undisturbed sample, specific gravity, Atterberg Limits, Sequential Batch Leach Test (SBLT)
- Random sediment samples: mineralogy by X-Ray Fluorescence (XRF)
- Sediment (mini-cores) from potential capping areas: shear strength, vane strength, triaxial compression
- Pore water from potential capping areas: PCBs as Aroclors, TOC, dissolved organic carbon (DOC)
- Leachate from SBLT (Sequential Batch Leach Test) on cap area sediments: DOC, TOC, PCBs as Aroclors
- Filter cake from press test: Proctor Test, compressive strength, triaxial compression, column leach test
- Leachate from column leach test on filter cake: zinc, iron, manganese, lead, cadmium, mercury, pH, conductivity, hardness, COD, BOD, TOC, DOC, ammonia, volatile organics, PCBs as congeners, PAHs, chloride, sulfate

The laboratory SOPs for these analytical parameters are contained in Appendix D. Sample collection procedures are described in SAP Section 2.3.3.

2.2 Analytical Methods Requirements

Samples will be collected, prepared, and analyzed in accordance with the analytical methods outlined in the SOPs (Appendix D). The specific analytical methods and RLs for each parameter are presented in Table 2. Preparatory methods for analytical parameters are included in the laboratory SOPs included in Appendix D. Table 3 lists the specific analyte that will be reported by the laboratory for volatiles, PAHs, each Aroclor and PCB congener, as well as the detection and RLs.

PCB congener analysis in Lower Fox River samples has historically been plagued by data comparability issues and congener domain reporting differences. Based on the sediment samples analyzed as part of the Green Bay Mass Balance Study, a subset of all 209 possible congeners is proposed for analysis. Listed in Table 3 are the 38 congener or congener domains that were at least 0.5 percent of the average total PCB concentration and summed together, comprise 95 percent of the total PCB concentration. AXYS will report these congeners or congener domains at a minimum.

Proper sample containers, preservation, holding times, and volumes for each analytical parameter are summarized in Table 4. En Chem will provide all sample containers and preservatives for the study. All sample containers supplied by En Chem will either be new or cleaned according to USEPA standards. QC documentation will be supplied with the sample containers and preservatives in order to verify their purity. The containers and preservatives will be traceable back to their certificate of analysis from their lot number. The QC documentation or Certificate of Analysis shall be maintained on file with En Chem. Additionally, En Chem will provide the field team with laboratory-grade deionized water (DI) for rinsing field equipment and instruments. Extra containers will be readily available to field staff as contingency for damaged or potentially contaminated containers and for use with samples of opportunity. Sample containers will be kept away from fuels and solvents.

2.3 Sample Handling and Custody Requirements

Proper sample handling and custody procedures are crucial to ensuring the quality and validity of data obtained through field and laboratory analyses. Sample-handling procedures include field documentation, COC documentation, sample shipment, and laboratory sample tracking. Various

aspects of sample handling and shipment, as well as the proposed sample identification system and documentation, are discussed in the following sections.

2.3.1 Sample Collection Documentation

Field Books

Detailed records of all field activities will be maintained in field books dedicated to the WDNR LFRPD. Entries will be dated and signed by personnel recording the data. All entries will be made in ink. Each field book will have a unique numerical identifier permanently attached, and each page will be numbered, permitting indexing of key data. At minimum, information recorded in the field books will include documentation of sample locations, sampling times, types of samples collected, weather conditions, and any other information pertinent to the investigation. OUs 3 and 4 will have a separate field book.

Field Sample Identification System

Each sample collected during the investigation will be given a unique identification code. Each unique sample identification code will consist of the following:

- **Project Identification Code**. A one-digit designation will be used to identify the OU from which the sample was collected as follows:
  - **3**- OU 3
  - **4**- OU 4
- **Location Code**. Each sample will be identified by four digits representing the sediment coring location:
  - **XXXX** sediment coring location
- **Depth Code**. Finally, each sample will be identified by a letter representing the 10-cm interval sampled. If the entire core length is analyzed (i.e. SBLT procedure), the sample number will have an AZ depth designation. The actual elevations corresponding to each 10-cm interval will be recorded in the Sample Control Log:
  - **A** sample start at surface elevation, sample end 10-cm deeper, (0 – 10 cm)
  - **B** sample start at end of A, sample end 10-cm deeper, (10-20 cm)

- **C** sample start at end of B, sample end 10-cm deeper, (20-40 cm)
- **D** sample start at end of C, sample end 10-cm deeper, (40-80 cm)
- **E** sample start at end of D, sample end 10-cm deeper, (80-100 cm)
- **F** sample start at end of E, sample end 10-cm deeper, (100-120 cm)
- **G-ZZ** smple start at end of F, sample end 10-cm deeper, etc
- **AZ** entire core length

- **Examples**
  - **30005B** OU 3 sediment core location 5, 10-20 cm section
  - **30117F** OU 3 sediment core location 117, 100-120 cm section
  - **40019AZ** OU 4 sediment core location 19, entire core length

All sediment core sections will be placed in freezer bags for shipment to the laboratories. Undisturbed samples will not be sectioned, but sent intact to the laboratories for analysis. En Chem will provide sample labels for all of the sample analyses, including those leachate samples generated by ARI from the SBLT and sent back to En Chem and to AXYS. The sampling contractor will supply the drive cylinders for the undisturbed samples. All sample containers will be labeled at the time of sample collection but prior to being filled with sample. For sediment samples placed in freezer bags, duplicate labels will be provided, one to be placed on the outside freezer bag and one placed in between the outer and inner freezer bags to be used by En Chem to label the aluminum pan used during air drying. Each label will be filled out with waterproof ink and will contain, at a minimum, the following information:

- Sample identification number
- Date/time of sample collection
- Sampler's initials
- Required analyses
- Type of preservative

Field Sample Handling

The possession and handling of samples will be documented from the time of sample collection to delivery to En Chem or CQM. The NRT field personnel will be responsible for ensuring that COC procedures are followed. Field personnel will maintain custody of all samples until they are relinquished to another custodian, the laboratory, or to the Core Processing Facility. The COC Standard Operating Procedure (SOP) is included in Appendix E.

All samples will be cataloged on the RETEC COC form using the unique sample identification codes. The date and time of collection will be recorded on the form, as well as the number of containers for each type of sample, the method of preservation, and the type of analysis required. A copy of the RETEC COC form is included in Appendix E.

Field Sample Packaging and Shipping

The field sampling team will deliver all samples to the Core Processing Facility for sectioning and subsampling into aliquots for chemical and/or physical analysis. Subsamples for analysis will be packaged and transported to the laboratories in a manner that maintains the integrity of the samples and that permits the analysis to be performed within the prescribed holding times. Samples for geotechnical and physical testing will be handled and packaged in accordance with ASTM D 4220-95. Prior to shipment, each sample container will be inspected for a label with the proper sample identification code. Samples will be packed in the cooler using bubble-wrap packing materials.

At the end of each working day, the coolers containing subsamples for analysis will be delivered to En Chem or CQM. Upon relinquishing the samples to En Chem or CQM, NRT field personnel will turn custody of the samples over to the laboratory by signing and dating the bottom of the COC form. The RETEC data manager will retain one copy of the COC form. The original COC form will accompany the sample to the laboratory.

If samples are shipped to a laboratory not in the Lower Fox River study area (non-regional laboratory), they will generally be shipped as hazardous materials according to the United States Department of Transportation (USDOT) regulations as described in 49 CFR. The exceptions would be in cases where it is believed or known that no hazardous materials are involved; in such cases, less stringent shipping procedures will be employed as a means of conserving project resources.

For shipments to the non-regional laboratory, the lead sampler will contact the designated point of contact and provide shipping information to include the carrier name and tracking number, the number of coolers being sent, and whether or not these samples are the last ones for the project. All

subcontractor laboratories will be prepared to accept Saturday delivery of samples.

Sample coolers for shipment will contain sufficient ice to maintained required temperature preservation of samples. The custody sheet and analysis request forms will be placed inside a watertight plastic bag taped to the inside of the cooler lid, and a return air bill account number will be included for the return of the coolers.

Field Documentation

Field COC procedures will ensure the proper documentation of each sample from collection in the field to delivery at the laboratory. Custody of samples shall be maintained and documented at all times in accordance with the NRT SOP in Appendix E. The documentation for each sample will include the following information:

- COC form
- Sample label with sample identification code
- Entry in the Sample Control Log
- Shipping documents, if any

This documentation will allow for proper identification and verification of all samples upon arrival at the laboratories. The laboratories will note the integrity of the samples on the COC form upon arrival.

2.3.2 Laboratory Chain of Custody

Each laboratory will employ laboratory custody procedures for sample receiving and login, sample storage, tracking during sample preparation and analysis, and storage of data in accordance with their SOPs. The laboratory Project Managers will be responsible for ensuring that laboratory custody protocol is maintained. The laboratory SOPs for sample custody are presented in Appendix D.

2.3.3 Custody Procedure for Final Evidence Files

RETEC will be responsible for the custody of the study evidence files and maintain and update the contents of the files. The evidence files will include all records relevant to sampling and analysis activities such as boring logs, field books, photographs, subcontractor reports, laboratory data deliverables, COC forms, and data validation reports. RETEC will retain this file for a period of 5 years after completion of the investigation.

2.4 Quality Control Requirements

2.4.1 Field Quality Control Requirements

During the investigation, NRT field personnel will strictly follow QC checks through the use of replicate measurements, equipment calibration checks, and data verification. Field sampling precision and representativeness will be evaluated through the use of co-located sediment cores. These sample replicates provide precision information regarding homogeneity, handling, transportation, storage, and analysis. Temperature blanks will monitor that adequate preservation has been maintained during sample shipping and/or delivery to the laboratories. Requirements for the field QA/QC samples are listed in Table 3. The number and type of field QC samples to be collected at each OU are identified in SAP Table 2-4. No additional sample collection volume is required for MS/MSD or lab duplicate analysis for sediments.

Temperature Blanks

In order to evaluate potential effects of sample transportation and handling on data quality, the field team will include a temperature blank in each sample cooler. A 40-milliliter VOC vial filled with unheated tap water will serve as an adequate temperature blank container. Unlike other sampling blanks, the temperature blank does not carry a sample number and will be clearly marked to indicate its purpose to the laboratory. The temperature blank will be handled in exactly the same manner as the actual samples and placed in the cooler in a manner that allows the laboratory to unpack it before unpacking the field samples. Upon receipt of the cooler by the laboratory, the sample custodian will measure the temperature of the water in the vial and record it on the associated chain-of-custody form. Corrective action is required if the temperature upon receipt at the laboratory is higher than 6°C.

Field Co-located Sediment Cores

Co-located sediment cores are collected to demonstrate the reproducibility of the sampling system, which includes the field conditions as well as the sampling equipment, personnel, and procedures. Therefore, co-located cores should be collected consecutively/concurrently on the same day and by the same personnel using the same equipment and procedures. Co-located cores are collected for each matrix sampled and at a frequency of at least 5 percent (1 per 20 project samples). This is a separate type of duplicate from that prepared and analyzed in the laboratory from a single subsample and should not be considered to replace a lab duplicate in any batch QC requirement in Table 3.

Field QC Sample Corrective Action

During data validation, qualified personnel will review the results of field QC samples and assess the impact on the associated project samples. For temperature blanks, corrective action is required if the temperature upon receipt at the laboratory is higher than 6°C. Corrective action is required if the variability between co-located field samples is greater than the limits established through the DQO process and documented in Table 3.

Where corrective action is required, it includes the following steps: (1) evaluation of the extent of the problem, (2) determination of the source of non-compliance, and (3) assessment of the impact on data usability. Depending on the intended uses of the data and the nature and extent of the problem, additional corrective actions may vary from flagging of the data to correction of faulty processes or techniques, replacement of contaminated materials or reagents, field personnel re-training, and/or re-sampling and re-analysis.

2.4.2 Laboratory QC Requirements

The laboratory QA manager will be responsible for ensuring that the laboratory's data precision and accuracy are maintained in accordance with specifications. The analytical procedures used in the LFRPD are listed in Table 2. In addition, Table 3 has been provided in this QAPP to summarize and clarify the detailed QC procedures and acceptance limits associated with each method. This QC requirement table format has proven to be effective in alerting the analyst to the main QC requirements for each analysis. In addition, all analysts will have in their possession the complete method as documented in the SOP(s), which will serve as the definitive description for QC requirements.

Laboratory QC samples (e.g., blanks, MS/MSD and laboratory control samples) will be included in the preparation batch with the field samples. An analytical batch is defined as a number of samples (not to exceed 20 environmental samples plus the associated laboratory QC samples) that are similar in composition (i.e., sediment matrix) and that are extracted or digested at the same time and with the same lot of reagents. MSs and MSDs count as environmental samples. The term analytical batch also extends to cover samples that do not need separate extraction or digestion (e.g., percent solids). The identity of each analytical batch will be unambiguously reported with the analyses so that a reviewer can identify the QC samples associated with each environmental sample.

2.5 Instrument Calibration and Frequency

Field and laboratory equipment used in the execution of work will be appropriate and approved for intended uses. The procurement and handling of

quality-affecting equipment will be controlled to ensure initial and continued conformance with applicable technical requirements and acceptance criteria. Quality-affecting materials that are to be controlled include, but are not limited to, field and laboratory measurement and testing equipment and sampling equipment.

The calibration procedures to be utilized for both the field and laboratory instruments used during the study are referenced in this section. Equipment used in the field and laboratory will be subjected to a formal calibration program. The program will require equipment of the proper type, range, accuracy, and precision to provide data compatible with the specified requirements and the desired results. Calibration of equipment may be performed internally using in-house reference standards, or externally by agencies or manufacturers.

Each laboratory will be responsible for the calibration of its laboratory equipment. NRT field personnel will be responsible for the calibration of equipment used in the field. Widely accepted procedures, such as those published by USEPA, and ASTM, or procedures provided by manufacturers in equipment manuals, will be used.

Field equipment will be uniquely identified by the manufacturer's serial number or an NRT equipment identification number. This identification, along with a label indicating when the next calibration is due (only for equipment not requiring daily calibration), will be attached to the equipment. If this is not possible, records traceable to the equipment will be readily available for reference. It will be the responsibility of field personnel to check the calibration status prior to using the equipment.

Equipment that fails calibration or becomes inoperable during use will be removed from service and segregated to prevent inadvertent use and will be tagged to indicate the fault. Such equipment will be repaired to the satisfaction of the laboratory personnel or NRT field personnel, or replaced, as appropriate.

Records will be prepared and maintained for calibrated equipment to document that established calibration procedures have been followed. Records for calibration of any rented equipment and NRT-owned field equipment used for this project will be kept in the project files. Each laboratory will maintain laboratory calibration records.

2.5.1 Field Instrument Use and Calibration

All field equipment will be selected so as to ensure that it is of the proper type, size, tolerances, and sensitivity range to support its intended use. All instruments used to collect field data will be calibrated with sufficient

frequency and in such manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications. Operation, maintenance and calibration procedures of the equipment proposed for the LFRPD are vendor specific. For LFRPD tasks in which WDNR has provided notice to proceed, SOPs are provided in the SAP for use and calibration of field instruments. For the LFRPD tasks not authorized to proceed, SOPs from selected vendors and subcontractors will be provided. SOPs include: differential global positioning system (DGPS) receiving antennae, real-time kinematics (RTK) positioning rovers, and the multi-sensor core logger. These SOPs must include the specific preventive maintenance, calibration and operation or reference the manufacturer's operating manual that includes this information.

Equipment used in the execution of work will be appropriate and approved for its intended use, and it will be operated, handled, maintained, and stored in accordance with the manufacturer's specifications. Sample collection and storage equipment will be cleaned, stored, and handled using the necessary precautions against cross-contamination, corrosion, and damage. Calibration procedures will be documented in the field book. Documentation will include the following:

- Date and time of calibration
- Name of the person performing calibration
- Reference standard used, if applicable
- Reading taken and adjustments to attain proper reading
- Any corrective action

Field equipment will be visually inspected before shipment to the field and again before use. Equipment, parts, or components that do not meet specifications (i.e., nonconforming items) will be identified in a manner that is easily recognized. These items will be controlled so as to prevent their inadvertent use or installation. Instrument maintenance logbooks and records, field SOPs, field logbooks, and field records are QA/QC records and subject to relevant requirements as established in the USEPA and WDNR QMPs. NRT field team members will examine equipment used during field sampling to verify that is in adequate operating condition. The NRT field team leader will periodically audit the calibration and performance of the field equipment to ensure that the equipment operates within the manufacturer's specifications.

2.5.2 Laboratory Instrument Calibration

The proper calibration of laboratory equipment is crucial to the quality of the analysis conducted by the laboratory. Calibration procedures are specified in each of the analytical methods in Appendix D and summarized in Table 3. All analytes reported must be present in the initial and continuing calibrations, and these calibrations must meet the acceptance criteria specified in the SOP

in Appendix D. Reported results will fall within the calibration range. Records of standard preparation and instrument calibration will be maintained. Records will unambiguously trace the preparation of standards and their use in calibration and quantitation of sample results. Calibration standards will be traceable to standard materials. Traceability to the National Institute of Standards and Technology (NIST) and USEPA standards will be maintained to the maximum extent possible, but the source of calibration will be documented in all cases.

2.5.3 Calibration Standards Preparation and Traceability

Traceability of standards will be accomplished by comparing in-house standards to USEPA or NIST materials, and by maintaining the required records. Whenever a standard is prepared, the manufacturer's lot number, the starting materials, the starting amount and volume, the source and volume of the solvent or acid, the date of preparation, and the initials of the technician will be recorded in a permanent, bound notebook. The accuracy of the standards will be established by comparison to previously prepared standards and by comparison to standards prepared independently from different starting materials. The percent difference between the newly prepared standard and the old or independent standard must not exceed 10 percent for the new standard to be considered acceptable for use in calibration.

2.6 Preventive and Remedial Maintenance

Field and laboratory equipment will be maintained on routine preventive maintenance schedules. Preventive and remedial maintenance will be performed and verified by qualified personnel and in accordance with approved procedures and manufacturer's recommendations. Maintenance records will be generated, retained, and reviewed as part of the project quality records. The maintenance schedules and procedures for this field equipment should be provided in SOPs by the selected sampling contractor or reference the manufacturer's operating manual that includes this information.

Maintenance activities will be documented in instrument-specific or field logbooks. Entries should include the following information:

- Equipment identification (e.g., type, model, serial number, and manufacturer)
- Procedure reference
- Date, description, and results of calibration/maintenance
- Name and affiliation of the person who performed maintenance

2.7 Inspection/Acceptance of Supplies and Consumables

Materials used in the execution of work will be appropriate and approved for intended uses. The procurement and handling of quality-affecting materials will be controlled to ensure initial and continued conformance with applicable technical requirements and acceptance criteria. These items will be visually inspected before shipment to the field and again before use. Inspection elements will include, as appropriate, a review of physical condition, expiration dates, limitations of use, size and quantity, and quality grade (e.g., reagents and solvents). Quality-affecting materials that are to be controlled include, but are not limited to, sample containers, DI water, calibration standards for field equipment, sample preservatives, disposable sampling supplies, disposable PPE, and electronic data storage media. Materials that do not meet performance specifications will be segregated and labeled to preclude use.

Chemical reagents, solvents and laboratory equipment will also be controlled to ensure initial and continued conformance with applicable technical requirements and acceptance criteria. Inspection elements will include, as appropriate, a review of physical condition, expiration dates, limitations of use, size and quantity, and quality grade (e.g., reagents and solvents). Quality-affecting materials that are to be controlled include, but are not limited to, sample containers, DI water, calibration standards, sample preservatives, disposable glassware, laboratory chemicals, reagents and solvents, sample preparation and extraction/digestion equipment, quantitative transfer apparatus and electronic data storage media. Materials that do not meet performance specifications will be segregated and labeled to preclude use.

2.7.1 Non-direct Measurements

The historical data used in the LFRPD are for the purposes of defining the OU boundaries and those deposits that have previously exhibited variability in the PCB concentrations. These historical PCB concentrations will aid in determining sampling locations and sampling density. All historical data used will be taken from the FRDB. The quality of the data in the FRDB has been documented by the WDNR in the Data Management Summary Report (WDNR, 2000). Only data in Table 3-2 of this report that has been identified being validated will be used to guide sampling activities. Any limitations of the data as noted in the validation reports will be considered before selecting final sampling locations.

2.8 Data Management

This section describes the process for the collection, organization, evaluation, and reporting of technical data to support the monitoring activities described in this document. The term technical data is used to refer to the field observations, laboratory analytical results, and validation data generated to interpret site conditions and characterize the performance of remedial actions.

In addition, this section describes the system used to make this data and the resulting work products available to personnel working on the project. The resulting work products are calculations, models, drawings, etc., that are derived from technical data, and the written reports used to document the evaluations. Additional types of data such as managerial data (e.g., audit reports, surveillance reports, storage records, project tracking records) are also maintained in the data management system.

NRT field technical staff members will manage raw data during field activities. Data such as depth measurements and water level will be recorded on the appropriate field forms (located in Appendix E) or in a field book. During the course of the investigation, the RETEC Data Manager will periodically collect field and laboratory data to maintain current summary of results. This will enable the RETEC Data Manager to identify any data gaps during the course of the project. Noted inefficiencies in field QA/QC will be brought to the attention of the RETEC QA Manager.

Each laboratory's Project Manager will be responsible for laboratory data management. Analytical data reports generated by each laboratory will present all sample results, including all QA/QC samples. All data, including QA/QC results, will become part of the project files and will be maintained by the RETEC Data Manager. Upon laboratory report delivery, RETEC personnel under the supervision of the RETEC Data Manager will analyze laboratory data in accordance with accepted statistical methodologies, if appropriate.

2.8.1 Data Management Plan

A data management plan will be developed and implemented for the LFRPD as environmental data storage and/or manipulation represent significant components of the project. The data management plan will identify project-specific computerized and manual systems, electronic format requirements, and control systems that ensure data integrity and compliance with USEPA Region 5 policies and requirements and allow for the data to be stored in the FRDB.

The data management plan will include procedures to ensure data integrity and security at each stage of data processing. The plan will specify where

each data set will be stored, how long each will be stored, and who may have access to the data and under what restrictions.

The data management plan will indicate, via a flow chart, each data transfer and reduction step in processing data. These flow charts will be used to trace a data set from stored data to the final deliverable. QC procedures will include random checks of transfer accuracy and completeness. Procedures will also address the reliability of calculations and the overall correctness of the data reduction. The algorithms and procedures used for data reduction will be verified against a known problem set.

Information that is stored in the FRDB will be audited periodically to verify record integrity, retrievability, and security. Periodic record audits will also be conducted to verify that the number of entries made equals the number of records logged and that data output correctly corresponds to data input.

Prior to "mixing" data sets or adding to an existing data set, the comparability of the data will be verified and documented. For this purpose, comparability will be based on the type of data, the comparability of the methods used to generate the data, the assessed quality of the data, and compatibility of the electronic files.

Approved data management procedures will be implemented to ensure the integrity of stored project data in terms of accuracy, completeness, and accountability. Data management procedures and controls will provide appropriate security against unauthorized retrieval or modification of the information, whether intentional or unintentional.

2.8.2 Electronic Information Management System (EIMS) Data Management

Technical data, including field observations, laboratory analytical results, and analytical data validation, lends itself to storage in a relational database structure in order to make the data queryable. The Agencies will manage this data using EQuIS®, a third-party database application that is becoming a standard for the management of environmental data (see www.earthsoft.com). Historical analytical data stored in the FRDB, the current data warehouse for Lower Fox River and Green Bay analytical data, will be available in EQuIS® format. In addition, requiring that data be provided in an EQuIS®-compatible format will facilitate importing future data (see http://www.epa.gov/region5superfund/edman/download/EDD%20V1_05.pdf).

The RETEC database manager will be responsible for uploading electronic sample collection form data into the EQuIS® database. Data received from analytical labs in EDD format, received as EQuIS® compatible text files from laboratories, will be checked for completeness by comparing them to the

sample collection form data before appending them directly into the EQuIS® database, where the records will be flagged as "Unvalidated." At this point, the analytical data will be available for search and download by users of the EIMS who have been granted permission to see unvalidated data. Data will be promptly exported and transmitted to a data validator, where the appropriate quality checks are completed. Finally, the RETEC database manager will upload updated results including Validation Qualifiers received from the data validators, and will make these results available to the general EIMS user community. In addition to analytical data, the EQuIS® database will be used to organize field observation data, including field parameter results. This data will be transcribed by field personnel into electronic files, where they will be uploaded into EQuIS® with the assistance of the RETEC database manager. This data will then be available for data evaluation though EQuIS® exports, as described below.

2.8.3 Data Reduction and Review

Procedures for ensuring the correctness of the data reduction process are discussed in this section. Data, both field and laboratory generated, are reduced either manually on calculation sheets or by computer on formatted printouts. Responsibilities for the data reduction process are delegated as follows:

- Technical personnel will document and review their own work and are responsible for the accuracy of the work
- Calculations will receive a method and calculation check by a secondary reviewer prior to reporting (peer review)
- The Chemistry QA Officer will be responsible for ensuring that data reduction is performed according to protocols discussed in this QAPP

In-Laboratory Data Reduction and Review

Data generated by the laboratory will be reviewed prior to release of the data. The laboratory will perform three levels of data review:

- Analytical level
- Data section level
- Final quality review

Laboratory review processes are documented in the Quality Assurance Manuals (Appendices A, B) or analytical SOPs (Appendix D). The laboratory will insert statements in a comment field to qualify data results. Data quality conditions and their associated qualifiers are listed in Table 3. Technical data

will be reported according to the established QA/QC procedures in Section 1.8.4. Special consideration will be given to replicate measurements, identification of outlier values, and results reported below detection limits, as discussed below.

Outliers, or numbers that lie outside of the expected range of values, may occur. Outlier values may be the result of an occurrence such as a spill, inconsistent sampling or analytical chemistry methodology, errors in transcription of data values, and actual but extreme concentration measurements. Outlier values will be corrected if the problem can be documented. Documentation and validation of the cause of outliers must accompany any attempt to correct or delete data values. Actual but extreme values will not be altered. Outlier values will be identified, but will not be omitted from raw data tables.

Analytical values determined to be at or below the RL but above the MDL limit will be reported numerically with a J qualifier to indicate that the value is estimated because it lies between the MDL and RL (or limit of detection (LOD) and Limit of Quantitation (LOQ)) where quantitation is less precise than above the RL (or LOQ). Values below the MDL or LOD will be reported as < XX, or XX U where XX is the numerical value for the MDL or LOD. Abbreviations such as "BDL" or symbols will not be substituted for the numerical detection limit when reported values are below the detection limit.

When computing statistics where one or more of the data values are below the detection limits, several approaches are possible (e.g., setting the sample value equal to zero, one-half the detection limit, or the detection limit). The statistical method used will determine what approach is specified. Regardless of the approach used, the respective assumptions will be indicated as a footnote in tables reporting statistical results.

2.8.4 Data Evaluation

Data evaluation involves the processing of technical and literature data to assess site conditions and to characterize the performance of remedial actions. Data evaluation will be conducted using a combination of database exports, industry standard analysis software, and user analysis.

2.8.5 Tabular Data

Presentation tables will consist of two types, raw data tables and reduced data tables. Raw data tables may not illustrate trends or patterns, but are valuable for validation and auditing purposes. Reduced data tables may present data as a function of depth, location, or matrix. Reduced tables also include tables derived from raw data tables by additional calculations or other manipulations, such as counts, averages, maximums, and 95% UCLs.

Raw data tables will be primarily created using the EQuIS® CrossTab Report Writer application, a general report writer designed to work with EQuIS® projects. This reporting tool is not a hard-coded report generator limited to a few "canned" report formats. Instead, the EQuIS® CrossTab Report Writer application is a highly configurable and customizable general purpose X-Tab report generator. This application will be used to export analytical data from the EIMS technical database to Microsoft® Excel or text file format. Export decisions, such as fields selected, sort orders, and filter criteria, are saved, thereby ensuring the reproducibility of the exports. Whenever a data export is completed to make a raw data table, the date and time of the export as well as a readable version of the SQL statement will be included with the export file.

Reduced data tables will generally be created using spreadsheet calculations. These files will be printed out in both equation form and calculation form. An engineer or scientist of a professional level equal to or higher than that of the originator will review all equations. The secondary reviewer will sign and date the calculation sheet immediately below the originator. Both the originator and secondary reviewer are responsible for the correctness of the calculations. The calculation sheet will document the following (at a minimum):

- Project title and project number
- Initials and date of originator
- Initials and date of secondary reviewer
- Basis for calculation
- Assumptions made or assumptions inherent in the calculation
- Complete reference for each source of input data
- Methods used for calculation
- Results of calculation

2.8.6 Maps and Drawings

The distribution of chemicals, if present, may be represented by superimposing contaminant concentrations over a map of the investigation area. Distributions may be shown by listing individual measurements or by contour plot of the contaminant concentrations or other parameters (isopleth map). Regardless of the method used, all maps will include a title, scale, legend, and north-arrow. The date, project number, and operator's name will also be included. Base maps used will be properly referenced. The contour interval will be indicated and contour lines will be labeled.

The primary tool to be used for the creation of maps and drawings will be ArcView, a product offered by ESRI. Data presented in these maps will include the results of raw data exports and data reduction results. Additionally, existing GIS layers available from previous work done on the

Lower Fox River and from regional government agencies may be included on these maps. All GIS layers used in the creation of maps and drawings will be available as files in the Document Management module of the EIMS.

2.8.7 Hand Calculations

At times, data evaluation may require the use of hand calculations. They will be recorded on calculation sheets, written legibly and in a logical progression. An engineer or scientist of a professional level equal to or higher than that of the originator will review the calculations. The secondary reviewer will sign and date the calculation sheet immediately below the originator. Both the originator and secondary reviewer are responsible for the correctness of the calculations. The calculation sheet will document the following (at a minimum):

- Project title and project number
- Initials and date of originator
- Initials and date of secondary reviewer
- Basis for calculation
- Assumptions made or assumptions inherent in the calculation
- Complete reference for each source of input data
- Methods used for calculation
- Results of the calculation

3 Assessment/Oversight

The assessment tools cited in the USEPA and WDNR QMPs that are most relevant and specific to environmental sampling and analysis are technical systems audits (TSA) of sampling systems, analytical and testing systems, and data management and validation systems. TSAs will be used to verify the effectiveness of and compliance of the LFRPD study with the QMPs and this QAPP.

Frequent audits will be completed to ensure that the field sampling activities and laboratory analyses are performed following the procedures established in this QAPP and the SAP (including the attached SOPs). The audits may be either internally or externally led, as further described below.

Inspection is a key real time component of QA/QC program. Field sample collection, core sectioning and sample processing as well as the analytical laboratories will be audited regularly. The physical and geotechnical analyses are often neglected or exempted from lab audits, but for this project these data are at least as critical to the design as the Aroclor value. On site capacity and capability audits prior to initiation of the analyses will be done, as well as follow-up on site audits during the actual analysis and collection to check compliance with the QAPP/SAP and resolve chronic data validation issues. Reconciliation of on site raw laboratory and field data with hard copy data packages and the reported electronic data will also be included in the on site audits.

The WDNR QA Manager con consultation with the USEPA QA manager, will establish the external audit schedule for the LFRPD study as prescribed in the QMP. To the extent practical the schedule will include representative tasks performed in support of each OU, and will include activities performed by all subcontractor organizations. The WDNR QA Manager will notify and invite the USEPA Remedial Project Manager and WDNR Project Manager to external TSAs. The WDNR QA Manager will inform USEPA of the results of audits and provide USEPA with written reports from management systems reviews and field and laboratory TSAs.

RETEC will support the WDNR QA Manager by conducting internal audits and reviews of LFRPD activities. The RETEC QA Manager will coordinate with the WDNR QA Manager and serve as the primary auditor during these activities. The RETEC QA Manager will communicate any noncompliance to the RETEC and WDNR Project Managers for corrective and preventive actions, and ensure that corrective actions are implemented and reported back to WDNR.

3.1 Field TSAs

The RETEC QA Manager will conduct audits of field activities. WDNR and USEPA may also conduct independent field audits. At least one field audit will be completed near the beginning of the sample collection activities for each OU and one during the height of sample collection and core processing. The field audit will consist of a checklist format developed from the requirements in this QAPP and the SAP. The audit checklist will address the following areas:

- Review of field-sampling records
- Review of field measurement procedures
- Examination of the core sectioning and resultant sample identification traceability
- Review of field instrument calibration records and procedures
- Verification of calibration of field instruments
- Review of the sample handling and packaging procedures
- Review of COC procedures

If deficiencies are observed during the audit, these deficiencies will first be relayed verbally to the NRT Field Team Leader and subsequently be noted in writing in a TSA report distributed to the NRT Field Team Leader and RETEC Project Manager. Corrective action procedures may need to be implemented due to the findings from the audit. The corrective actions will be documented in the field book. A follow-up audit may be completed, if deemed necessary by the RETEC Project Manager to verify that corrective action was done.

The NRT field personnel will be present at the OU at all times during sampling activities and audits. The field personnel will provide all on-site supervision required during the project and will contact the NRT field team leader daily. The NRT field team leader will then review compliance with the project objectives and sampling protocol outlined in this QAPP and the SAP. Any anticipated modifications to the sampling or data collection procedures will be reported to the WDNR and USEPA Project Managers. NRT field technical staff members will report any necessary modifications to the RETEC Project Manager and document the modification in the field book.

3.2 Laboratory Audits

Each laboratory QA Manager will be responsible for ensuring that the laboratory data generated are in accordance with the QAPP specifications and laboratory SOPs. The laboratories will be externally audited prior to the start of analysis and during the course of the analysis by the RETEC QA Manager. If additional laboratories are required to handle the sample analysis loads, they will be audited by the RETEC QA Manager both prior to and during sample analysis. In addition, laboratories may be independently audited by WDNR and USEPA , at the discretion of the WDNR and USEPA Project Managers.

The laboratory audit will consist of a checklist format developed from the requirements in this QAPP. The audit checklist will address the following areas:

- Review of sample log-in, storage and preparation records
- Review of corrective action documentation and effectiveness
- Compliance of analytical procedures used with SOPs
- Review of instrument calibration records and procedures
- Calibration standards documentation and traceability
- Traceability of reported electronic and hard copy results to raw data
- Review of the data handling and reporting procedures
- Review of COC procedures

If deficiencies are observed during the audit, these deficiencies will first be relayed verbally to the laboratory Project Manager and subsequently be noted in writing in a TSA report distributed to the laboratory Project Manager and RETEC Project Manager. Corrective action procedures may need to be implemented due to the findings from the audit. The corrective actions will be documented in the field book. A follow-up audit may be completed, if deemed necessary by the RETEC Project Manager to verify that corrective action was done.

3.2.1 Laboratory Data Package TSAs

All laboratory results will be reviewed by the laboratory Project Manager prior to submittal to RETEC and the WDNR Project Managers. This internal TSA will assess the following:

- Completeness of both electronic and hard copy data package deliverables
- Compliance with Table 2 parameters, methods and RLs
- Table 3 QC sample frequency and limits met
- Holding times met
- Need for data qualifiers or additional narrative

In addition, independent external TSAs of the laboratory data packages will be done by the MAKuehl Company. Due to the large number of samples collected and analyzed for each OU, classical data validation using full data packages supplied by the laboratory and verifying that each reported result is traceable to the raw data is not practical. In order to provide for efficient and consistent inspection of the data reported, all laboratories supplying data will comply with a standardized electronic reporting format. All of the project data will be entered into the LFRPD database as described in Section 2.8 along with the quality control results as required in Table 3. Independent validation of these data will then occur using the spirit of USEPA Region 5's Standard Operating Procedure for Validation of CLP Organic Data, April 1991, revised February 1997, last revised November 2002; but conducted using the LFRPD specific criteria developed for each analyte (i.e., Aroclors, density, grain size, percent solids, etc.) as listed in Table 3. Results of validation from the database may trigger classical validation on up to 10 percent of the total number of samples collected. In addition, during the start up of sample analyses at each OU and by each laboratory, the first several data packages generated must be classically validated to prove that the laboratories are complying with this QAPP. During on site audits of the laboratory, recently submitted data will be used to trace the reported results to the raw data. At the discretion of the RETEC and WDNR QA Manager, other sample results will be selected for classical validation randomly, based on unusual conditions noted in the field or by other analysis results from the same sample. Each classical validation event will generate a validation report that will be transmitted along with the validated data. All validated data will be indicated as such in the database. The validation process and rationale for all data qualifiers added will be documented and submitted to the WDNR and USEPA.

3.2.2 Performance Evaluation Audits

The capability of analytical systems to perform routine measurements will be evaluated by the RETEC QA Manager based on the results of performance evaluation (PE) sample analysis. The PE audit answers questions about whether the measurement system is operating within control limits and

whether the data produced meet the analytical specifications and are comparable to data generated by other laboratories and historical data. The critical elements for review of PE results include: (1) correct identification and quantitation of PE sample analytes, (2) accurate and complete reporting of the results, and (3) measurement system operation within established control limits for precision and accuracy.

LFRPD PE samples will consist of the Lower Fox River sediments used in the method validation study (Appendix C). At least one of these sediments will be submitted to each subcontractor laboratory conducting PCB analysis in Lower Fox River sediments during procurement and as needed to assess the laboratory's performance throughout the life of the contract. The laboratory is required to report a result that is within the calculated 95 percent confidence limit from the validation study for satisfactory PE sample performance. Once selected as a LFRPD laboratory, each facility will be required to submit periodic PE sample results to assist in continual performance evaluation and establishment of precision and accuracy data for PCBs in the Lower Fox sediment matrix.

3.3 Data Management and Validation Systems

RETEC's operations for data management and data validation will be audited on a formal basis under the direction of the RETEC Project Manager by a qualified staff member independent of data entry and validation. At a minimum, these audits will include an evaluation of data management systems and procedures, configuration control, software validation techniques, transcription and data entry procedures, data change management, data transfer procedures and controls, data review and validation procedures, record keeping, and the qualifications of data validation personnel.

3.4 Corrective Action

RETEC's quality system is focused on problem prevention and continual improvement. To the extent that problems do occur, the quality system is designed to ensure timely identification and resolution, and to prevent re-occurrence. By implementing the QC checks of the individual SOPs, technical personnel will identify each nonconforming condition at its occurrence and institute the needed corrective actions in a timely manner.

With regard to data quality, short-term corrective actions will be implemented in response to minor incidents of noncompliance. Short-term corrective actions may include the re-calibration of field or laboratory equipment using freshly prepared calibration standards, repetition of the preparation and analysis of samples associated with unacceptable QC results, replacement of reagent lots associated with unacceptable blank values, repair or replacement of field or laboratory equipment, recalculation of sample data, or re-

instruction of field or laboratory personnel. These types of corrective actions are generally implemented soon after the noncompliant condition is identified and do not usually have long-term or serious implications.

Long-term corrective actions will be implemented in response to major or systemic noncompliance. Long-term corrective actions may include a change in technical or management approach, major revision to an existing SOP (such as the introduction of additional or precautionary steps), substitution or modification of an approved method or technique, and personnel re-training or re-assignment to achieve a better fit between personnel skills and technical requirements. The need for such actions may be identified by RETEC or WDNR personnel through routine operations, TSAs, and management reviews.

Corrective actions will be verified by the RETEC QA Manager and documented as appropriate. Short-term corrective actions will be verified by an independent technical reviewer and documented through explanatory notes on the affected data sheet(s) and report(s). Long-term corrective actions will be verified by the RETEC and WDNR Project Managers and documented through formal corrective action reports to management. The level of effort and degree of management involvement will also depend on the nature, extent, and severity of the problem.

3.5 Reports to Management

During the study, six types of reports including the Final Report will be prepared by the RETEC Project Manager and submitted to the WDNR and USEPA Project Managers. These six reports will be will be submitted electronically:

- Bi-weekly Project Status Reports
- Weekly Field Progress Reports
- Weekly Laboratory Progress Reports
- Monthly Progress Reports
- Annual Report
- Final Report (the BODR)

A list indicating which of these reports will also be submitted in hard copy format is provided in section 4.1.3 of this QAPP. These reports will serve to inform the WDNR and USEPA of the project progress and any significant interim findings. This will streamline the process of addressing issues as they arise and modifying the program to better address the environmental concerns. The RETEC project team will complete a peer review of all reports prior to submittal to the WDNR and USEPA. A distribution list with number of copies to each party is included in this QAPP, which includes address and

mail code for hard copy distribution as well as email for electronic distribution of each party.

Jim Hahnenberg, USEPA Region 5 Remedial Project Manager 2 copies
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Chicago, IL 60604

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Ben.Hung@dnr.state.us
Wisconsin Department of Natural Resources
101 S. Webster St., Box 7921
Madison, WI 53703-7921

3.5.1 Bi-weekly Project Status Reports

Bi-weekly project status reports will be prepared for submittal to the WDNR Project Manager. The status reports will summarize the following:

- Field and laboratory activities that were completed in the previous two weeks
- Field and laboratory activities scheduled for completion the next two weeks
- Address the project schedule
- Document correspondence with agencies and site visitors

3.5.2 Weekly Field Progress Reports

A weekly field progress report will be submitted to summarize the following:

- Field investigation activities conducted the week prior
- Field investigation activities schedules for the completion the next week
- Copies of Chain-of-Custody receipts for samples submitted to the analytical laboratory
- Sample control log for samples/cores submitted for analysis of geotechnical or engineering properties
- Variance log

The variance log will document investigation activities that were inconsistent with the QAPP and/or the SAP with a brief description of the variance and reason for the variance. The variance log will be submitted to the Project Quality Assurance Manager to assess how variances may affect the quality of the data to meet the objectives of the project and the need for additional field investigation activities.

3.5.3 Weekly Laboratory Progress Reports

A weekly laboratory progress report will be submitted to summarize the following:

- Samples received by the laboratory (analytical and geotechnical) the week prior
- Samples processed by the laboratory (analytical and geotechnical) the week prior
- Deviations from the laboratory standard operating procedures (SOPs)
- Summaries of any samples which were analyzed outside of the holding time, or had to be re-analyzed due to interferences, poor recoveries, poor on-going calibration results, or any other laboratory difficulties
- Analytical and geotechnical sample results, if available (final results only)

3.5.4 Monthly Progress Reports

A monthly progress report will be submitted with each invoice, and will summarize the following:

- Project milestones and activities (field and laboratory) that have been completed over the invoiced period of time
- Project milestones and activities (field and laboratory) that will be completed over the next month
- A summary of all variances and QA/QC deficiencies
- A summary of the project schedule with a revised schedule provided, as necessary
- A budget summary including billed-to-date, current invoice, and project budget remaining

3.5.5 Annual Reports

Annual reports will be prepared to summarize the following:

- A summary of the methods and techniques used to collect the sediment samples
- Project milestones and activities (field and laboratory) that have been completed
- Laboratory methods used to analyze sediment samples
- A summary of all variances, QA/QC audits, and QA/QC deficiencies
- Final analytical data will be presented in tabular and graphical format, as appropriate, such that sample results exceeding 1 ppm for PCBs highlighted
- River cross sections, topographic and geophysical mapping (including features which may restrict capping alternatives) as appropriate
- Data validation reports, if available

3.5.6 Basis of Design Report

The final report, which will be the BODR, will include information from the bi-weekly/weekly progress reports and annual reports. The purpose of this report will be to summarize the results of the pre-design sampling and treatability program in such a way as to document final decisions on technology process option selection and to support the remedial design process. The content of the BODR will be used to finalize the engineering design of the remedy, to size process equipment and facilities, and then to prepare final construction plans and specifications suitable for a contractor bidding process.

The BODR will include the following elements:

Section	Content
Extent of impacts	• Tabular summary of PCB results • Contour map of sediment bed elevation, including x,y footprint of material exceeding the 1 ppm RAL • Contour map of the bottom of the 1 ppm RAL • Calculation of volume of material exceeding the 1 ppm RAL
Site conditions	• Description of existing conditions that will affect the construction of the remedy, such as utilities and other subsurface obstructions. (Note that this section will be based on the interpretation of the sub-bottom and sidescan imagery generated during the site mapping tasks.)
Treatability – solids	
Protocol A: Sediment screening and classification	• Summary of the classification of sediments by grain size and other physical properties.
Protocol B: Slurry pre-processing and thickening	• Summary of slurry preparation, solids measurements and results of column settling tests. • Description of test results in the context of basin or thickener sizing.
Protocol C: Mechanical dewatering and residuals characterization	• Description of dewatering test results and the scale-up considerations for full-scale equipment sizing. Includes a discussion of the use and rate of addition of chemical conditioners. • Description of the physical and strength testing of the dewatered cake and how the results affect design and operation of a monofill for disposal. • Summary of leach testing results and their impact on design of a monofill liner.
Protocol D: Characterization of passively-dewatered residuals	• Description of the physical and strength testing of the dewatered sediment and how the results would reflect long-term settlement in an NR500 monofill. Include consideration for cover design and stability. • Summary of leach testing results and their impact on design of a monofill liner.

Section	Content
Treatability–wastewater (Protocol E)	• Description of jar testing and recommended chemical additive and dosage for full-scale wastewater clarification. • Interpretation of column settling test results and implications on sizing/selection of a full-scale clarifier.
Testing to support in-situ capping	• Description of the physical and pore-water testing results (Section 2.8) and how they would support the design of an in-situ cap.
Design concepts	• Description of recommended capping, removal, dewatering, wastewater treatment, and/or disposal processes (for each OU) • Process Flow Diagram and updated mass balance (for each OU) • Facilities locator plan (drawing), showing the proposed locations of staging, processing and disposal facilities necessary to implement the final remedy. Include transportation routes and/or intermediate materials handling steps. (Note: Geotechnical data from specific riverside parcels (Section 2.9) would be included here.)
List of drawings and specifications	• A list of all construction drawings and specification sections that will be developed during the final design process.
Permits	• A list of all local, state and federal permits required to implement the remedy. • Include approvals or access agreements necessary to construct and operate all remediation facilities.
Cost estimate	• An updated construction cost estimate based on the design concepts described herein. (Note: In USACE terms, this would be a pre-design "current working estimate (CWE)". In Superfund terms, it would be a post- FS estimate, but not yet an estimate based on a final design. As such, it would typically have an uncertainly level somewhere between +50%/-30% and +15%/-10%.
Schedule	• GANTT chart showing major tasks required to implement the project, including final design, permits and approvals, procurement and construction

In addition to the BODR, the final report will also include the following:

- Analytical results presented in tabular and graphical formats to define the approximate area of sediments exceeding 1 ppm for PCBs. This area will define the area of impact for use in preparation of plans and specifications.

- An approximate volume of material to be removed.

- Areas of sediment appropriate for in-place capping

- Engineering and geotechnical properties of the sediment for use in selecting the appropriate dredging equipment.

4 Data Validation/Usability

The quality of data will be assessed to establish usability for their intended purpose and to foster continuous improvement in data collection efforts by identifying major or recurring sources of error. Data quality assessment will include data review, verification of compliance with SOPs and attainment of DQOs, data validation, and determination of data usability.

For the purposes of this plan and any plan developed through its use, data review is defined as the process whereby the technical merit of data is determined by the organization that generates the data. During this process, achieved QC results are compared to method-specified criteria to determine whether the analyses were performed under controlled conditions. Because data review criteria are based on the analytical methods used to generate the data, the review process and results are independent of the intended use of the data. Before submitting data, each laboratory is responsible for reviewing their data, implementing corrective actions where possible, and reporting nonconformance and the corresponding corrective actions, as applicable. Field crews will review their data and implement any necessary corrective actions before submitting their data for use. This data will be included in the final report for the project, which will be the BODR.

For the purposes of this plan and any plan developed through its use, data validation is defined as the independent verification of the quality and integrity of environmental data. During this process, data deliverables will be evaluated as follows: (1) SOP compliance is determined; (2) data traceability is verified from raw data to custody documentation to reporting forms; (3) calculations and transcriptions are checked, (4) QC results are evaluated against Table 3 specifications and the applicable project DQOs, and (5) data are qualified as necessary to denote limitations on usability.

4.1 Data Flow and Checking

Each analytical SOP that is cited in Table 2 provides detailed instructions and equations for calculating analyte concentrations. Section 1.6 of this QA Project Plan describes calculations related to QC requirements.

The analyst performing the analysis will review all results with respect to QC requirements. Compiled results will be further reviewed by at least one other qualified individual at the laboratory, with respect to completeness of the data package and compliance with all contractual and in-house QC requirements. The RETEC QA Manager or his/her designee will provide a final independent review of the completed data package with respect to contract compliance and data usability.

4.1.1 Project-Specific Requirements

Analytical results will be communicated directly from the laboratory to RETEC, and then only to the WDNR Project Manager. In no case will reports, results, or data be released to a third party without prior written permission from the WDNR Project Manager. Disk deliverable data will be prepared whenever possible by direct electronic transfer from analytical instruments to avoid transcription errors.

4.1.2 Reporting the Results of Analyses

Data will be supplied in both electronic and hardcopy media. Both reports will consist essentially of a listing specifying the RETEC identification (ID) number, the internal laboratory ID number, the sample date, the data prepared and/or analyzed, the method, the matrix, the parameter(s) and the measured concentration(s), units, and the detection limit. QC sample results will be reported in similar format with cross-references to unambiguously relate QC results to their associated environmental samples. The electronic data will be in a format compatible with Access.

4.1.3 File Management

This section describes the system storing and accessibility of hard copy and electronic data and documents. The intent of this system is to act as the repository of knowledge pertaining to the Lower Fox River project, including technical data, managerial data, project reports, and reference material. Records created during this project will be maintained in hardcopy and/or electronic format, as described further below. Several specific records that will be created and maintained are listed below; additional records may be generated, as needed. A distribution list with number of copies to each party is included in Section 3.5 of this QAPP, which includes address and mail code for hard copy distribution as well as email for electronic distribution to each party.

Anticipated Project Records

Document	Description	Hardcopy Format	Electronic Format
Sediment Core Drive Logs	Field forms	X	
Sediment Core Processing Logs	Field forms	X	X
Chain-of-Custody forms	Field forms	X	
Bathymetric and Side Scan Sonar Survey Log*	Field forms*	X*	
Field Notebooks	Field technician notes	X	

Document	Description	Hardcopy Format	Electronic Format
Photographs	Digital photos with accompanying identification data		X
Laboratory Documentation	Complete data packages including: Analytical data / Geotechnical data and graphs, narrative information, COC documentation	X	X
Laboratory EDD	Electronic deliverable of analytical data		X
Sediment Core Log	Interpretation of field log data		X
Bathymetric XYZ data*	Both raw data and cleaned-up data will be maintained*		X*
Bathymetric and Side Scan Sonar Interpretation*	Maps and imagery created from the survey data*	X*	X*
Bathymetric and Side Scan Sonar Annotated Printout	As collected at time of survey	X	X
GIS layer raw information*	As collected from data source (village, municipality, city, organization)*	X*	X*
Technical System Audits (TSAs)	Audit reports	X	X
Daily activity report during geophysical surveys	Field forms*	X*	

*Indicates project records that will be generated during the independent project contract "Survey Control And Topographic And Bathymetric Mapping On Lower Fox River."

To support this inventory, the Agencies have also developed and administer a secure web-based EIMS that is available to WDNR and its designated contractors. The EIMS includes five modules:

- **Document Management –** Warehousing of information objects (i.e., reports, memos, GIS layers, laboratory EDDs) in order to make them available for search, retrieval and downloading. The Document Management module stores descriptive information (metadata) that characterizes data and documents created or referenced to support the Lower Fox River project, as well as the ability to link files when they are available in electronic format.

- **Schedule –** Presentation and tracking of status of tasks

- **Financial –** Budget and project controls (module not completed at time of printing)

- **Analytical and Collection Data –** Warehousing, indexing, and retrieval of analytical and collection data records

- **GIS –** Presentation of:
  - Document Management Information Objects that are geo-referenced (GIS layers)
  - Database records
  - Schedule data (not completed at time of printing)

Hard Copy Document Management

A copy of all technical data, reports, managerial data, and reference material will be filed in a central location in WDNR's Madison office. Hard copy data that is generated in the field will be protected to the extent practical and transferred to RETEC's office on a regular basis. The RETEC Document Manager will send the original document to WDNR's Madison office and retain a copy for project team use. Each information product will be cataloged in the EIMS Document Management module, along with a reference code identifying its location in the central file location. A WDNR librarian will be tasked with maintaining consistency with the project files and the EIMS Document Management module. WDNR and RETEC will maintain the project records for 5 years following completion of this project.

Electronic Document Management

Electronic document management will be modeled after the EIMS system developed by the USEPA's Office of Research and Development (see www.epa.gov/eims/eims.html). The EIMS stores and maintain descriptive information (metadata) that characterizes work products created or referenced to support the Lower Fox River project. This descriptive information, such as geographical extent, date, and content origin, can be used as search parameters for the EIMS user community through a standard web browser. The EIMS will provide storage for metadata in seven information categories representing known forms of environmental information objects. Unless stated otherwise, data objects under each of these categories will be searchable through the Document Management portion of the EIMS, and available for download. The data categories are:

- **Database –** This data, commonly referred to as the FRDB, will be migrated to a different data structure and made available online.
- **Data Sets –** Collections of data not residing in a formal database management system. Examples of these include side-scan sonar and bathymetric data (generated during the independent project contract "Survey Control And Topographic And Bathymetric Mapping On Lower Fox River"), PCB mass calculations, sediment volume calculations (e.g., any information derived from, and used

in the RI/FS or the remedial design, often created in Microsoft Excel).

- **Spatial Data –** Environmental information that incorporates geographic identifiers in its composition and is capable of being displayed in geographic/mapping images. Examples include interpolated bed maps, habitat overlays, wetlands maps, and local area highways/population use. Spatial data structure should be compatible with WDNR management systems. Spatial data will be available for presentation online through additional functionality.

- **Design Drawings –** Documents created using Computer Aided Design software, primarily AutoCAD.

- **Models –** A centralized system where the current models used for the Lower Fox River can all be placed, operated as required, and all output data catalogued and stored.

- **Documents –** The Records Inventory houses records such as memoranda, abstracts, books, book chapters, legislative bills, reports on congressional hearings, journal articles, newspaper articles, informal reports, draft and final USEPA reports, theses, dissertations, and unpublished works.

- **Multimedia Products –** Pictures and images, sound files, and videos.

EIMS Data Management

Analytical data in the EQuIS data structure will be available to users of the EIMS. Data fields available for searching and/or presenting in reports and exported tables include the following:

Data Set	Location	Deposit
Sample Matrix	Risk Pathway	Sample Type
Analysis Type	Analyte	Data Qualification
Analyte Result Threshold	Sample ID	Result Value
Result Unit	Validation Qualifier	Northing
Easting	Start Depth	End Depth
Depth Units	Common Name	Blind ID
Core Grab	County	Depth
Detection Limit	EcoRisk	HHRisk
Lab Name	Lab Extraction Date	Lab ID
Lab Receipt Date	Method	QA Status
Reporting Basis	Sample Area	Sample Date
Sampled By	SDG	Source
Validator		

EIMS GIS Layer Management

The EIMS allows users to view data that is geographically referenced. As described below, this includes geo-referenced layers, analytical data that is identified with survey data, and sample planning information.

- **Geographically Referenced Documents –** Information objects that are described as Spatial Data in the Document Management module of the EIMS are available as themes for online viewing presentation using GIS. The interface allows several functionalities: zoom, identify, zoom to full extent, zoom to current theme, pan, and select by polygon. The interface allows the user to select active themes and turn visibility of themes on and off. All layers are required to use a common datum (NAD 83/91).

- **Analytical Data –** In addition to presentation of layers, GIS functionality also includes posting of analytical data results values stored in the Database module of the EIMS. The same fields available for creating reports and exports will also be available for querying posted analytical results, and will allow for the comparison of results values with defined action levels.

- **Schedule Data –** GIS functionality allows for tracking of scheduling of analytical results by using a color coding system to distinguish between planned samples, unvalidated samples, and validated and accepted samples.

EIMS Security

The EIMS is a restricted access site. Users must receive a login name and password from a site administrator to gain access to the site. The administrator assigns each user to a Security Role that has the appropriate level of rights to View, Edit, Add and Delete records. Contacts can be associated with more then one Security Role. In cases where permissions are inconsistent, the more permissive rules are observed. For example, if a user is added to a Security Role called "Document Viewer" that allows view privileges only and a Security Role called "Document Editor" that allows both view and edit privileges, the user will have view and edit privileges.

EIMS Administration

RETEC hosts the EIMS application and performs incremental backups daily and full backups monthly. RETEC will keep the backup tapes for 1 year.

4.1.4 Detection Limits and Reporting

The MDL is the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is

greater than zero. The laboratory will establish MDLs for each method, matrix, and analyte for each instrument the laboratory plans to use for the project according to the procedures in 40 CFR 136, Appendix B. The laboratory will revalidate these MDLs at least once per 12-month period. To be confident in the quantitation of the analyte, the measured concentration must not only exceed the instrument/MDL but also exceed a quantitation limit. The quantitation limit for the LFRPD will be expressed as the RL. The RL in Wisconsin is calculated as 3.3 X MDL with a J qualifier to indicate that the value is imprecise from its location in this region of quantitation.

4.1.3 Notification of Lost Samples, Reporting Error, Out-of-Control Samples, or Loss of Capability

RETEC will notify the WDNR Project Manager of nonconforming conditions that may potentially impact the quality or timeliness of analysis. At the same time, proposed corrective actions will be presented. Nonconforming conditions would include out-of-control results or supporting documentation, inadvertently destroyed or lost samples, or the loss of a laboratory capability that may adversely affect analytical test results.

4.2 Verification and Validation Methods

Data reduction, validation, verification, and archiving for the LFRPD will be similar to that required by the USEPA Contract Laboratory Program (CLP), with certain modifications as noted below. LFRPD data will be evaluated as outlined in the CLP National Functional Guidelines for Inorganic (EPA 540/R-94/012, 1994) and Organic (EPA 540/R-99/008, 1999) Data Review, and as appropriate to the methods in this QAPP. Data validation will also be performed in accordance with the appropriate Region 5 procedures e.g., USEPA Region 5's Standard Operating Procedure for Validation of CLP Organic Data, April 1991, revised February 1997, last revised November 2002).

The laboratory will apply the appropriate data qualifiers if acceptance criteria are not met and corrective action is either not successful or not performed. The RETEC QA Manager will review the electronic data report and determine if the data quality objectives have been met. In addition, 10 percent of the data will be validated by a third-party data validation service, the MAKuehl Company.

4.3 Reconciliation with User Requirements

The suitability of environmental data for their intended use(s) will be determined. Data usability involves an evaluation of the quantity, type, and overall quality of generated data against the project objectives. The usability of data that are associated with QC results outside established acceptance

criteria is generally dependent on the degree of the exceedance, whether the potential bias is high or low, and whether the uncertainty implied by the exceedance is significant. Unless otherwise specified by WDNR, usability will be assessed in accordance with the draft USEPA guidance "Contaminated Sediment Remediation Guidance for Hazardous Waste Sites, OSWER 9355.0-85, November 2002."

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Tables

Table 1
Summary of Chemical, Physical, Geotechnical, and Treatability Tests

Data Need	Recommended Calculations, Tests, or Measurements	Basis for Sample Location	Remedy Component That Is Affected By the Results
Chemical Characteristics – in-river sediment	Solids – PCBs, percent solids	***Random and/or phased*** – Complete coverage of soft sediment areas based on physical survey and previous data collection results.	***Dredging*** – Delineation (x, y, z) of the 1 ppm PCB dredge prism.
	Solids – PCBs, TOC SBLT - PCBs, TOC, DOC Porewater – PCBs, TOC, DOC	***Focused*** – These tests would be performed at locations in OU 1, OU 3 and OU 4 that are appropriate for capping.	***Capping*** – These data would serve as input to the USACE RECOVERY model to account for contaminant flux in cap design.
Physical – survey control	Establish permanent benchmarks using WTM 83/91 and NAVD 88	***Focused*** – Benchmarks should be established along each OU to serve as survey control during future remedial construction and/or removal.	***All*** – This activity will provide a consistent basis for vertical and horizontal positioning for the pre-design sampling, and later for remedial construction on or adjacent to the river.
Physical Conditions in–river sediment	Bathymetry and side-scan sonar	***Complete coverage*** of OU 1, OU 3 and OU 4.	***Capping and Dredging*** – These measurements define the lateral extent of soft sediment for delineation characterization. They also identify debris and obstructions that a dredging contractor must address.
Physical Properties – in-river sediment	Grain size Bulk unit weight % solids Specific gravity Atterberg limits	***Random*** – The samples can be collected as a % of the total number of cores taken, but must represent all major deposits of material.	***Dredging*** – The test results will collectively be used to calculate the amount of dry solids in a given volume of sediment. This is then used for sizing the dredge equipment and slurry conveyance necessary to achieve a given removal rate. ***Dewatering*** – The amount of dry solids generated per unit of time also determines sizing. ***Disposal*** – The quantity of solids ultimately determines the volume of dewatered material, and hence the volume of landfill space needed. ***Capping*** – Properties like the Atterberg limits are used in the evaluation of cap designs.
Geotechnical – *in-situ* materials	Shear strength –Field vane shear, unconfined compressive strength (laboratory), and/or triaxial compression test (laboratory);	***Focused*** – Testing locations should be in areas and deposits that are being contemplated for cap construction. Requires undisturbed samples	***Capping*** – This testing is necessary to perform final design of the cap, in particular the ability of the in-place material to support the weight of the overlying cover materials.
Geotechnical – dewatered solids	Triaxial compression Proctor test	***Focused*** – These tests would be done on samples of passively or mechanically dewatered sediment	***Disposal*** – These tests determine strength properties of the dewatered filter cake that may be destined for landfilling. The data is used in the stability analysis of the filling operations and to determine acceptable final grades.

Table 1
Summary of Chemical, Physical, Geotechnical, and Treatability Tests

Data Need	Recommended Calculations, Tests, or Measurements	Basis for Sample Location	Remedy Component That Is Affected By the Results
Treatability – sediment characteristics	Mineralogy – x-ray fluorescence	***Random*** – A number of samples can be randomly collected. Only applicable to OU 3 and OU 4, where vitrification may be considered as a means of treatment/disposal.	***Disposal via vitrification*** –If vitrification is considered as a means of filter cake disposal, then the mineral characteristics of the sediment are important because they affect the operational aspects of the process (sediment handling and flux addition.)
Leach testing	Leach testing on filter cake from filter press and belt press testing. Leachate analyzed for metals (Fe, Zn, Mn, Pb, Cd, Hg), PCB (congeners), hardness, conductance, pH, BOD, COD, sulfate, chloride, ammonia, volatile organics and PAHs.	***Focused*** – The simulated filter cake that is generated from the bench-scale testing of filter presses and/or belt presses would be subjected to standard leaching test.	***Disposal*** – the leaching characteristics of the dewatered sediment could be used to select an innovative, protective liner design that may result in reduced capital costs.

Table 2
Analytical Parameters, Methods, Laboratory Reporting Limits For LFRPD Study

Sample Type(s)	Analytical Parameter	Laboratory	Prep/Analysis Methods	Reporting Limit	Action Limit	Action Limit Source
column test leachate of filter cake and sediment	zinc	En Chem	MET-45/MET-27	3.4 ug/L	12 – 333 mg/L	State of Wisconsin Water Quality Parameter Ranges for Substances With Acute Toxicity Related to Water Quality
column test leachate of filter cake and sediment	iron	En Chem	MET-45/MET-27	21 ug/L		
column test leachate of filter cake and sediment	manganese	En Chem	MET-45/MET-27	0.78 ug/L		
column test leachate of filter cake and sediment	lead	En Chem	MET-45/MET-27	1.4 ug/L	12 – 356 mg/L	State of Wisconsin Water Quality Parameter Ranges for Substances With Acute Toxicity Related to Water Quality
column test leachate of filter cake and sediment	cadmium	En Chem	MET-45/MET-27	0.43 ug/L	6 – 457 mg/L	State of Wisconsin Water Quality Parameter Ranges for Substances With Acute Toxicity Related to Water Quality
column test leachate of filter cake and sediment	mercury	En Chem	MET-30	0.056 ug/L	1.3 mg/L	State of Wisconsin Wildlife Criteria
column test leachate of filter cake and sediment	hardness	En Chem	MET-45/MET-27, MET-29	see table 3		
column test leachate of filter cake and sediment	COD	En Chem	WCM-40	see table 3		
column test leachate of filter cake and sediment	BOD	En Chem	G2-WCM-51	see table 3		
column test leachate of filter cake and sediment	ammonia	En Chem	WCM-25/WCM-58	see table 3		
column test leachate of filter cake and sediment	chloride	En Chem	WCM-60	see table 3		
column test leachate of filter cake and sediment	sulfate	En Chem	WCM-60	see table 3		
column test leachate of filter cake and sediment	Volatile organics	En Chem	G3-VOA-1	see table 3		
column test leachate of filter cake and sediment	PAHs	En Chem	G3-SVO-08/SVOA-37	see table 3		
column test leachate of filter cake and sediment	PCB Congeners	Axys	MLA-007	see table 3		
filter cake	column leach test	ARI	ASTM D4874	see table 3		
column test leachate of filter cake	pH	ARI	618S	see table 3		
column test leachate of filter cake	conductivity	ARI	611S	see table 3		
pore water, SBLT leachate	DOC	En Chem	WCM-2 and WCM-18	see table 3		
pore water, SBLT leachate	TOC	En Chem	WCM-2 and WCM-18	see table 3		
pore water, SBLT leachate	PCB as Aroclors	En Chem	SVOA-6, 52	see table 3		
sediment	PCBs as Aroclors screen	En Chem	IMMU-1, 2, 3	0.50 ppm	1 ppm	ROD
sediment	PCBs as Aroclors	Enchem	SVO-57, 26, 27/K-SVO-77	0.050 ppm	1 ppm	ROD
sediment	TOC	En Chem	WCM-9 and WCM-18	see table 3		
sediment	% solids	En Chem	LAB-16	see table 3		
sediment	% solids (air dried sample)	En Chem	K-SVO-77	see table 3		
cap areas sediment	SBLT sample prep	ARI	ARI	see table 3		
undisturbed sediment	bulk unit weight	CQM	Con Mat 2-7	see table 3		
sediment, filter cake, dewatered sediment	density	CQM	Con Mat 2-7	see table 3		
dewatered sediment, filter cake	consolidation	ARI	ASTM D2435	see table 3		
ndisturbed sediment, filter cake, dewatered sediment, slur	% solids	CQM	Con Mat 1-2	see table 3		
undisturbed sediment, filter cake	triaxial compression	SET	D2850, D4767	see table 3		
undisturbed sediment	compressive strength	ARI	D2166	see table 3		
sediment	grain size	CQM	Con Mat 1-5	see table 3		
sediment	specific gravity	CQM	Con Mat 1-7	see table 3		
sediment, filter cake, dewatered sediment	Atterberg Limits	CQM	Con Mat 1-6	see table 3		
sediment	vane shear test	in field	D4648	see table 3		
sediment	mineralogy by XRF	The Mineral Lab	XRF	see table 3		
filter cake	Proctor test	CQM	Con Mat 2-2 or 2-3	see table 3		

Table 3
LFRPD Quality Control Acceptance Criteria

Quality Control Acceptance Criteria for PCBs as Aroclors in Porewater and SBLT Leachate Analysis

Source: En Chem SOPs SVOA-6, 52

SOP #	Analyte	Detection Limit (ug/L)	Reporting Limit (ug/L)	Precision Water (% RPD)	Accuracy Water (% R)
SVO-6, 52	Aroclor 1016	0. 0.26	1.0	Not established	Not established
SVO-6, 52	Aroclor 1221	0. 0.26	1.0	Not established	Not established
SVO-6, 52	Aroclor 1232	0. 0.26	1.0	Not established	Not established
SVO-6, 52	Aroclor 1242	0. 0.26	1.0	Not established	Not established
SVO-6, 52	Aroclor 1248	0. 0.26	1.0	Not established	Not established
SVO-6, 52	Aroclor 1254	0. 0.26	1.0	Not established	58 –124 %
SVO-6, 52	Aroclor 1260	0. 0.26	1.0	Not established	Not established

SOP#	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
SVO-6, 52	Aroclor 1242, 1254	Five-point initial calibration (ICAL)	Initial calibration prior to sample analysis	Calibration factor of each peak $\leq$ 20 % RSD	Correct problem, then repeat initial calibration
SVO-6, 52	Aroclors 1016/1260, 1221, 1232, 1248	Five-point initial calibration only if detected in sample(s) (ICAL) 3 point for Aroclor 1221	Initial calibration prior to sample analysis	Calibration factor of each peak $\leq$ 20 % RSD	Correct problem, then repeat initial calibration
SVO-6, 52	Aroclors 1016/1260, 1221, 1232, 1248	One point midrange calibration standard	With each Aroclor 1242 and 1254 initial calibration	Calibration factor of each peak $\leq$ 20 % RSD	Correct problem, then repeat initial calibration
SVO-6, 52	All Aroclors	Qualitative match for Aroclor identification	Every sample	Minimum 5 peak match for all Aroclors except Aroclor 1221 (3 peak match)	None, do not report as detected Aroclor
SVO-6, 52	All Aroclors	Confirmation analysis on second column	Every sample	Minimum 5 peak match for all Aroclors except Aroclor 1221 (3 peak match)	None, do not report as detected Aroclor

Table 3
LFRPD Quality Control Acceptance Criteria

SOP#	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
SVO-6, 52	All Aroclors	Retention time window	Each calibration verification	ICAL mean RT $\pm$ 0.03 minutes	Correct problem, then reanalyze all samples analyzed since the last retention time check
SVO-6, 52	Aroclors 1242, 1254	Calibration verification. Alternate the Aroclors used.	After every 10 samples	Average RF of $\geq$ 5 peaks $\leq$ 15 % difference from ICAL mean RF	Correct problem, then repeat initial calibration verification and reanalyze all samples since last successful calibration verification
SVO-6, 52	Aroclors 1242 or 1254	Ending calibration verification. Either.	After all samples analyzed	Average RF of $\geq$ 5 peaks $\leq$ 15 % difference from ICAL mean RF	If sensitivity increased > 15 %, no reanalysis of undetected samples needed. If sensitivity decreased > 15 %, reanalyze detected samples
SVO-6, 52	All Aroclors	Method blank (MB)	One per analytical batch of 20 samples or less	No analytes detected $\geq$ RL	Correct problem, then repeat prep and analysis of method blank and all samples with detects < 20 X MB processed with the contaminated blank
SVO-6, 52	Aroclor 1254	LCS (level at about 5 X RL)	One LCS per analytical batch of 20 samples or less	69 – 131 %	Assess all other batch QC for same bias, if consistent bias present, repeat prep and analysis of LCS and all samples in the affected analytical batch

Table 3
LFRPD Quality Control Acceptance Criteria

SOP#	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
SVO-6, 52	All Aroclors	Surrogate spikes (TMX, DCB)	Every sample, spiked sample, standard, and method blank	TMX: 52 – 134 % DCB: detected – 148 %	If both TCX and DCB out of limit, re-extract and re-analyze sample
SVO-6, 52	All Aroclors	Blind duplicate submitted by RETEC	1 from each OU	< 20 % RPD	Qualify existing data as estimated, examine other datapoints, may resample
SVO-6, 52	Aroclor 1254	MS/MSD (level at 10 – 100 X RL)	One MS/MSD per every 20 project samples	65 – 135 %	If both MS and MSD recoveries out of limit, qualify data and note in case narrative suspected matrix problem

Quality Control Acceptance Criteria for SBLT Sample Preparation for Sediments

Source: ARI, Inc.

SOP #	Analyte	Detection Limit	Precision Soil (% RPD)	Accuracy Soil (% R)
#649s	TOC	See En Chem	See En Chem	See En Chem
#649s	DOC	See En Chem	See En Chem	See En Chem
#311s; #335s; #336s; #345s; #403s	PCBs	See En Chem	See En Chem	See En Chem

SOP#	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
#311s; #335s; #336s; #345s; #403s; #649s	TOC, DOC, PCBs	Prep blank	One per analytical batch of 20 or fewer samples	< Table 2 MDL	Notify ARI to assess SBLT reagents and process, qualify affected sample data with B code
#311s; #335s; #336s; #345s; #403s; #649s	All	Blind duplicate submitted by RETEC	1 from each OU	< 20 % RPD	Qualify existing data as estimated, examine other datapoints, may resample

Table 3
LFRPD Quality Control Acceptance Criteria

Quality Control Acceptance Criteria for Column Leachate Test Sample Preparation for Filter Cake

Source: ARI 611S, 618S, D4874

SOP #	Analyte Generated	Detection Limit	Precision (% RPD)	Accuracy (% R)
618S	pH	NA	± 0.10 S.U.	± 0.05 S.U.
611S	conductivity	1 uS/cm	< 20 % RPD	± 10 %
ASTM D4874	TOC	See En Chem	See En Chem	See En Chem
ASTM D4874	DOC	See En Chem	See En Chem	See En Chem
ASTM D4874	Ammonia	See En Chem	See En Chem	See En Chem
ASTM D4874	Sulfate	See En Chem	See En Chem	See En Chem
ASTM D4874	Chloride	See En Chem	See En Chem	See En Chem
ASTM D4874	BOD	See En Chem	See En Chem	See En Chem
ASTM D4874	COD	See En Chem	See En Chem	See En Chem
ASTM D4874	PAHs	See En Chem	See En Chem	See En Chem
ASTM D4874	Volatiles	See En Chem	See En Chem	See En Chem
ASTM D4874	Metals	See En Chem	See En Chem	See En Chem
ASTM D4874	hardness	See En Chem	See En Chem	See En Chem
ASTM D4874	PCBs as congeners	See Axys	See Axys	See Axys

Quality Control Acceptance Criteria for PCB Congener Analysis in Column Leachate from Filter Cake

Source: Axys SOP MLA-007

Method	Analyte	Detection Limit (ng/L)	Reporting Limit (ng/L)	Precision Water (% RPD)	Accuracy Water (% R)
MLA-007	BZ# 28	0.342	1.0	< 20 % if conc > 10 X MDL	70 – 130 %
MLA-007	BZ# 31	0.386	1.0	< 20 % if conc > 10 X MDL	70 – 130 %
MLA-007	BZ# 8 + 5	0.450	1.0	< 20 % if conc > 10 X MDL	60 – 130 %
MLA-007	BZ# 66 + 80	2.80	5.0	< 20 % if conc > 10 X MDL	70 – 130 %
MLA-007	BZ# 95 + 93	0.400	1.0	< 20 % if conc > 10 X MDL	70 – 130 %
MLA-007	BZ# 16 + 32	0.427	1.0	< 20 % if conc > 10 X MDL	70 – 130 %
MLA-007	BZ# 33	0.430	1.0	< 20 % if conc > 10 X MDL	70 – 130 %
MLA-007	BZ# 22	0.197	1.0	< 20 % if conc > 10 X MDL	70 – 130 %
MLA-007	BZ# 70 + 76	2.52	5.0	< 20 % if conc > 10 X MDL	70 – 130 %
MLA-007	BZ# 18	0.146	1.0	< 20 % if conc > 10 X MDL	70 – 130 %
MLA-007	BZ# 17	0.112	1.0	< 20 % if conc > 10 X MDL	70 – 130 %

Table 3
LFRPD Quality Control Acceptance Criteria

Method	Analyte	Detection Limit (ng/L)	Reporting Limit (ng/L)	Precision Water (% RPD)	Accuracy Water (% R)
MLA-007	BZ# 44	0.279	1.0	< 20 % if conc > 10 X MDL	70 – 130 %
MLA-007	BZ# 41 + 64 + 71 + 68	1.51	5.0	< 20 % if conc > 10 X MDL	70 – 130 %
MLA-007	BZ# 37	0.095	1.0	< 20 % if conc > 10 X MDL	70 – 130 %
MLA-007	BZ# 42 + 59	0.745	1.0	< 20 % if conc > 10 X MDL	70 – 130 %
MLA-007	BZ# 52 + 73	0.409	1.0	< 20 % if conc > 10 X MDL	70 – 130 %
MLA-007	BZ# 56 + 60	2.21	5.0	< 20 % if conc > 10 X MDL	70 – 130 %
MLA-007	BZ# 49 + 43	0.525	1.0	< 20 % if conc > 10 X MDL	70 – 130 %
MLA-007	BZ# 47 + 48 + 75	1.23	5.0	< 20 % if conc > 10 X MDL	70 – 130 %
MLA-007	BZ# 26	0.203	1.0	< 20 % if conc > 10 X MDL	70 – 130 %
MLA-007	BZ# 77 + 110	0.292	1.0	< 20 % if conc > 10 X MDL	70 – 130 %
MLA-007	BZ# 206	0.482	1.0	< 20 % if conc > 10 X MDL	70 – 130 %
MLA-007	BZ# 74 + 61	1.91	5.0	< 20 % if conc > 10 X MDL	70 – 130 %
MLA-007	BZ# 132 + 168	0.667	1.0	< 20 % if conc > 10 X MDL	70 – 130 %
MLA-007	BZ# 153	0.548	1.0	< 20 % if conc > 10 X MDL	70 – 130 %
MLA-007	BZ# 196 + 203	7.18	10	< 20 % if conc > 10 X MDL	70 – 130 %
MLA-007	BZ# 195	3.06	5.0	< 20 % if conc > 10 X MDL	70 – 130 %
MLA-007	BZ# 208	1.09	5.0	< 20 % if conc > 10 X MDL	70 – 130 %
MLA-007	BZ# 201	0.305	1.0	< 20 % if conc > 10 X MDL	70 – 130 %
MLA-007	BZ# 84 + 92	0.267	1.0	< 20 % if conc > 10 X MDL	70 – 130 %
MLA-007	BZ# 118 + 106	0.227	1.0	< 20 % if conc > 10 X MDL	70 – 130 %
MLA-007	BZ# 101 + 90 + 89	0.609	1.0	< 20 % if conc > 10 X MDL	70 – 130 %
MLA-007	BZ# 6	0.182	1.0	< 20 % if conc > 10 X MDL	60 – 130 %
MLA-007	BZ# 163 + 138 + 164	0.781	1.0	< 20 % if conc > 10 X MDL	70 – 130 %
MLA-007	BZ# 87 + 115 + 116	0.860	1.0	< 20 % if conc > 10 X MDL	70 – 130 %
MLA-007	BZ# 146	0.228	1.0	< 20 % if conc > 10 X MDL	70 – 130 %
MLA-007	BZ# 40	0.562	1.0	< 20 % if conc > 10 X MDL	70 – 130 %

Table 3
LFRPD Quality Control Acceptance Criteria

Method	Analyte	Detection Limit (ng/L)	Reporting Limit (ng/L)	Precision Water (% RPD)	Accuracy Water (% R)
MLA-007	BZ# 182 + 187	0.897	1.0	< 20 % if conc > 10 X MDL	70 – 130 %
MLA-007	BZ# 149 + 139	0.373	1.0	< 20 % if conc > 10 X MDL	70 – 130 %
MLA-007	BZ# 99	0.135	1.0	< 20 % if conc > 10 X MDL	70 – 130 %
MLA-007	BZ# 180	0.240	1.0	< 20 % if conc > 10 X MDL	70 – 130 %
MLA-007	BZ# 45	0.304	1.0	< 20 % if conc > 10 X MDL	70 – 130 %
MLA-007	BZ# 24 + 27	0.556	1.0	< 20 % if conc > 10 X MDL	70 – 130 %

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
MLA-007	All	Five-point initial calibration (ICAL)	Initial calibration prior to sample analysis	RRF RSD $\leq$ 20 %	Correct problem, then repeat initial calibration
MLA-007	All	Sensitivity check	Daily before ICAL	S/N ratio $\geq$ 3:1 for 10 pg BZ# 118	Correct problem, then repeat initial calibration
MLA-007	All	Bracketing Calibration	Every 12 hours	RRF agree to within $\pm$ 20 %	Correct problem, then repeat initial calibration and associated samples
MLA-007	All	Continuing calibration (CAL VER)	Begin and end of analysis	RRF agree to within $\pm$ 20 % of the mean RRF from ICAL	Correct problem, then repeat initial calibration and associated samples
MLA-007	All	Chromatogram quality – maximum peak width	Daily	BZ# 209 symmetrical with minimal tailing, peak width < 20 sec.	Correct problem, then repeat initial calibration and associated samples
MLA-007	All	Chromatogram quality – resolution	Daily	BZ# 28/31 valley height $\leq$ 80 % of smaller peak	Correct problem, then repeat initial calibration and associated samples
MLA-007	All	Retention time window	Each calibration verification	RRT $\pm$ 3 seconds of predicted RT from calibration std adjusted relative to labeled surrogate, native must elute after labeled analogue	Correct problem, then reanalyze all samples analyzed since the last retention time check

Table 3
LFRPD Quality Control Acceptance Criteria

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
MLA-007	All	Procedural blank	One per analytical batch of 20 samples or less	< 1 ng or < 10 % sample concentration	Correct problem, then repeat prep and analysis of blank and all samples with detects < 10 X MB processed with the contaminated blank
MLA-007	All	Surrogate spikes	Every sample, spiked sample, standard, and method blank	13C BZ# 3: 15 – 130 % 13C BZ# 15: 20 – 130 % all rest: 40 – 130 %	Qualify associated sample data if no re-extraction possible
MLA-007	All	Blind duplicate submitted by RETEC	1 from each OU	< 20 % RPD	Qualify existing data as estimated, examine other datapoints, may resample
MLA-007	All	Lab duplicate	One per every 20 project samples, if sufficient sample volume provided	< 20 % RPD if conc > 10 X MDL	Qualify associated sample data
MLA-007	All	MS/MSD	One MS/MSD per every 20 project samples	Mono, di chloro: 60 –130 %, all rest: 70 – 130 %	If both MS and MSD recoveries out of limit, qualify data and note in case narrative suspected matrix problem

Quality Control Acceptance Criteria for SBLT Leachate, Pore Water and Filter Cake Column Test Leachate Analyses

Source: En Chem or ARI SOP as listed below

Method	Analyte	Result Unit	Detection Limit	Reporting Limit	Precision Water	Accuracy Water
618S	pH	S.U.	NA	0.10	± 0.10 S.U.	± 0.05 S.U.
611S	Conductivity	uS/cm	1.0 uS/cm	2.0 uS/cm	20% RPD	± 10 %
WCM-40	COD	mg/L	11	50	14 % RPD	54 – 143 %
G2-WCM-51	BOD	mg/L	NA	2.0	20% RPD	85 – 115 %
WCM-58	Ammonia	mg/L	0 0.11	0 0.25	12 % RPD	79 – 111 %
WCM-2,18	DOC	mg/L	0 1.0	2.0	14 % RPD	66 – 122 %
WCM-2,18	TOC	mg/L	0. 1.0	2.0	14 % RPD	66 – 122 %
WCM-60	Sulfate	mg/L	0.072	2.0	10 % RPD	80 – 110 %
WCM-60	Chloride	mg/L	0.076	2.0	10 % RPD	70 – 118 %

Table 3
LFRPD Quality Control Acceptance Criteria

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
618S	pH	Initial 3 point calibration	daily	Manufacturer dependent	Make new buffers, recalibrate
618S	pH	Calibration verification	After every 10 samples	7.00 $\pm$ 0.05 S.U.	Repeat to verify, if still out, recalibrate and reanalyze all associated samples
618S	pH	Lab duplicate	One per analytical batch of 20 or less samples	< 20 % RPD	Repeat analysis, report RSD with data
618S	pH	Blind duplicate submitted by RETEC	1 from each OU	< 20 % RPD	Qualify existing data as estimated, examine other datapoints, may resample
611S	conductivity	Cell constant adjustment	Every 3 months or when calibration fails	1413 $\pm$ 1 %	Enter "Adjust to" value as new cell constant
611S	conductivity	2 point calibration	Daily	1413 $\pm$ 1 %	Recalibrate
611S	conductivity	blank	Daily, after calibration and after every 10 samples	< 1.0 uS	Recalibrate and repeat analysis of associated samples
611S	conductivity	Calibration Verification Standard (CVS)	After calibration and after every 10 samples	$\pm$ 10 %	Recalibrate
611S	conductivity	Lab duplicate	One per analytical batch of 20 or less samples	$\pm$ 20 %	Repeat analysis, report RSD with data
611S	conductivity	Blind duplicate submitted by RETEC	1 from each OU	< 20 % RPD	Qualify existing data as estimated, examine other datapoints, may resample
WCM-40	COD	6 point initial calibration (ICAL)	Daily initial calibration prior to sample analysis	Correlation coefficient $\geq$ 0.995 for linear regression	Correct problem, then repeat initial calibration
WCM-40	COD	Second-source calibration check standard (ICV)	Once per ICAL, immediately after	Analyte within $\pm$ 10% of expected value	Correct problem, then repeat initial calibration
WCM-40	COD	Initial calibration blank (ICB)	Once per ICAL, after ICV, before sample analysis	Absolute value $\leq$ 50 mg/L	Correct problem, then repeat initial calibration

Table 3
LFRPD Quality Control Acceptance Criteria

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
WCM-40	COD	Calibration verification (CCV)	After every 10 samples and at the end of the analysis sequence	± 10% of expected value	Correct problem, then repeat calibration and reanalyze all samples since last successful calibration
WCM-40	COD	Continuing Calibration blank (CCB)	After every CCV	Absolute value ≤ 50 mg/L	Correct problem, then repeat prep and analysis of CCB and all samples processed with the contaminated blank
WCM-40	COD	Method blank	One per analytical batch of 20 or less samples	Absolute value < 11 mg/L	Correct problem, then repeat prep and analysis of method blank and all samples processed with the contaminated blank
WCM-40	COD	LCS	One LCS per analytical batch of 20 or less samples	90 – 117 %	Correct problem, then repeat prep and analysis of LCS and all samples in the affected analytical batch
WCM-40	COD	MS/MSD	One MS/MSD per every 20 project samples per matrix	If sample > 4 X MS/MSD level, no limits apply Recovery: 54 - 143 % RPD: < 14 %	Qualify with "N" if recovery out, then do post digest spike. Qualify with "*" if RPD out
WCM-40	COD	Blind duplicate submitted by RETEC	1 from each OU	< 20 % RPD	Qualify existing data as estimated, resample
G2-WCM-51	BOD	Calibrate DO meter	Daily before read samples	Use water saturated air, see YSI manual	Check membrane, replace as needed
G2-WCM-51	BOD	Dilution water DO	Initially before set lab blanks	DO = 8.3 – 8.9 mg/L	See SOP section 10.4

Table 3
LFRPD Quality Control Acceptance Criteria

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
G2-WCM-51	BOD	Dilution water method blank	Daily, set up in duplicate	< 0.2 mg/L	Recalibrate meter Bleach dilution water containers
G2-WCM-51	BOD	Lab duplicate	After every 10 samples	$\leq$ 20 % RPD	Qualify data
G2-WCM-51	BOD	Blind duplicate submitted by RETEC	1 from each OU	< 20 % RPD	Qualify existing data as estimated, examine other datapoints, may resample
G2-WCM-51	BOD	Glucose-Glutamic acid standard	At beginning of set up and after every 10 samples	198 $\pm$ 30.5 mg/L	Qualify data
WCM-58	Ammonia	6 point initial calibration (ICAL)	Daily initial calibration prior to sample analysis	Correlation coefficient $\geq$ 0.995 for linear regression	Correct problem, then repeat initial calibration
WCM-58	Ammonia	Second-source calibration check standard (ICV)	Once per ICAL, immediately after	Analyte within $\pm$ 10% of expected value	Correct problem, then repeat initial calibration
WCM-58	Ammonia	Initial calibration blank (ICB)	Once per ICAL, after ICV, before sample analysis	Absolute value < 0.10mg/L	Correct problem, then repeat initial calibration
WCM-58	Ammonia	Calibration verification (CCV)	After every 10 samples and at the end of the analysis sequence	$\pm$ 10% of expected value	Correct problem, then repeat calibration and reanalyze all samples since last successful calibration
WCM-58	Ammonia	Continuing Calibration blank (CCB)	After every CCV	Absolute value < 0.10mg/L	Correct problem, then repeat prep and analysis of CCB and all samples processed with the contaminated blank
WCM-58	Ammonia	Method blank	One per analytical batch of 20 or less samples	Absolute value < 0.060 mg/L	Correct problem, then repeat prep and analysis of method blank and all samples processed with the contaminated blank

Table 3
LFRPD Quality Control Acceptance Criteria

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
WCM-58	Ammonia	LCS	One LCS per analytical batch of 20 or less samples	71 – 126 %	Correct problem, then repeat prep and analysis of LCS and all samples in the affected analytical batch
WCM-58	Ammonia	MS/MSD	One MS/MSD per every 20 project samples per matrix	Recovery: 79 – 111 % RPD: < 12 %	Qualify with "N" if both recoveries out, "MS" if one out. Qualify with "*" if RPD out
WCM-58	Ammonia	Blind duplicate submitted by RETEC	1 from each OU	< 20 % RPD	Qualify existing data as estimated, examine other datapoints, may resample
WCM-2, 18	DOC, TOC	Update calibration factor with 3 standards	Initially and as needed when calibration failures occur	CC>/= 0.995	Correct problem, then repeat initial calibration
WCM-2, 18	DOC, TOC	Calibration check standard ICV at 10 mg/L	Daily	90 – 110 %	Correct problem, then repeat initial calibration verification
WCM-2, 18	DOC, TOC	Initial calibration blank (ICB)	Once per initial daily multipoint calibration, before sample analysis	Absolute value < 1.0 mg/L	Correct problem, then repeat initial calibration verification
WCM-2, 18	DOC, TOC	Calibration verification (CCV)	After every 10 samples and at the end of the analysis sequence	± 10% of expected value	Correct problem, then repeat calibration and reanalyze all samples since last successful calibration
WCM-2, 18	DOC, TOC	Continuing Calibration blank (CCB)	After every CCV	Absolute value < 2.0 mg/L	Correct problem, then repeat prep and analysis of CCB and all samples processed with the contaminated blank

Table 3
LFRPD Quality Control Acceptance Criteria

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
WCM-2, 18	DOC, TOC	Method blank	One per analytical batch of 20 or less samples	Absolute value < 2.0 mg/L	Correct problem, then repeat prep and analysis of method blank and all samples processed with the contaminated blank. Flag between MDL & EQL
WCM-2, 18	DOC, TOC	Sample quadruplicate	Every sample	% RSD < 20 % if level > 5 X EQL	Repeat analysis, dilute, repeat until acceptable.
WCM-2, 18	DOC, TOC	LCS	One LCS per analytical batch of 20 or less samples	78 – 113 %	Correct problem, then repeat prep and analysis of LCS and all samples in the affected analytical batch
WCM-2, 18	DOC, TOC	MS/MSD	One MS/MSD per every 20 project samples per matrix	Recovery: 66 – 122 % RPD: < 14 %	Qualify with "N" if both recoveries out, "MS" if one out. Qualify with "*" if RPD out
WCM-2, 18	DOC, TOC	Blind duplicate submitted by RETEC	1 from each OU	< 20 % RPD	Qualify existing data as estimated, examine other datapoints, may resample
WCM-60	Sulfate	6 point initial calibration (ICAL)	Daily initial calibration prior to sample analysis	Correlation coefficient $\geq$ 0.995 for linear regression	Correct problem, then repeat initial calibration
WCM-60	Sulfate	Second-source calibration check standard (ICV)	Once per ICAL, immediately after	Analyte within $\pm$ 10% of expected value	Correct problem, then repeat initial calibration
WCM-60	Sulfate	APG check standard	Weekly separation column check	Analyte within $\pm$ 10% of expected value	Clean or replace separation column, repeat ICAL
WCM-60	Sulfate	Initial calibration blank (ICB)	Once per ICAL, after ICV, before sample analysis	Absolute value $\leq$ 2.0 mg/L	Correct problem, then repeat initial calibration

Table 3
LFRPD Quality Control Acceptance Criteria

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
WCM-60	Sulfate	Calibration verification (CCV)	After every 10 samples and at the end of the analysis sequence	± 10% of expected value	Correct problem, then repeat calibration and reanalyze all samples since last successful calibration
WCM-60	Sulfate	Continuing Calibration blank (CCB)	After every CCV	Absolute value ≤ 2.0 mg/L	Correct problem, then repeat prep and analysis of CCB and all samples processed with the contaminated blank
WCM-60	Sulfate	Method blank	One per analytical batch of 20 or less samples	Absolute value ≤ 2.0 mg/L	Correct problem, then repeat prep and analysis of method blank and all samples processed with the contaminated blank
WCM-60	Sulfate	LCS	One LCS per analytical batch of 20 or less samples	85 – 111 %	Correct problem, then repeat prep and analysis of LCS and all samples in the affected analytical batch
WCM-60	Sulfate	MS/MSD	One MS/MSD per every 20 project samples per matrix	Recovery: 80 – 110 % RPD: < 10 %	Dilute sample and reprep MS/MSD on diluted sample. Qualify with "N" if both recoveries out, "MS" if one out. Qualify with "*" if RPD out
WCM-60	chloride	6 point initial calibration (ICAL)	Daily initial calibration prior to sample analysis	Correlation coefficient ≥ 0.995 for linear regression	Correct problem, then repeat initial calibration
WCM-60	chloride	Second-source calibration check standard (ICV)	Once per ICAL, immediately after	Analyte within ± 10% of expected value	Correct problem, then repeat initial calibration

Table 3
LFRPD Quality Control Acceptance Criteria

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
WCM-60	chloride	APG check standard	Weekly separation column check	Analyte within ± 10% of expected value	Clean or replace separation column, repeat ICAL
WCM-60	chloride	Initial calibration blank (ICB)	Once per ICAL, after ICV, before sample analysis	Absolute value ≤ 2.0 mg/L	Correct problem, then repeat initial calibration
WCM-60	chloride	Calibration verification (CCV)	After every 10 samples and at the end of the analysis sequence	± 10% of expected value	Correct problem, then repeat calibration and reanalyze all samples since last successful calibration
WCM-60	chloride	Continuing Calibration blank (CCB)	After every CCV	Absolute value ≤ 2.0 mg/L	Correct problem, then repeat prep and analysis of CCB and all samples processed with the contaminated blank
WCM-60	chloride	Method blank	One per analytical batch of 20 or less samples	Absolute value ≤ 2.0 mg/L	Correct problem, then repeat prep and analysis of method blank and all samples processed with the contaminated blank
WCM-60	chloride	LCS	One LCS per analytical batch of 20 or less samples	90 – 110 %	Correct problem, then repeat prep and analysis of LCS and all samples in the affected analytical batch
WCM-60	chloride	MS/MSD	One MS/MSD per every 20 project samples per matrix	Recovery: 70 – 118 % RPD: < 10 %	Dilute sample and reprep MS/MSD on diluted sample. Qualify with “N” if both recoveries out, “MS” if one out. Qualify with “*” if RPD out

Table 3
LFRPD Quality Control Acceptance Criteria

Quality Control Acceptance Criteria for Volatile Organics Analysis in Leachate

Source: En Chem SOP G3-VOA-1

Method	Analyte	Detection Limit (ug/L)	Reporting Limit (ug/L)	Precision Water (% RPD)	Accuracy Water (% R)	Assoc. Is
G3-VOA-1	1,1,1-Trichloroethane	0.69	1.0	20 %	80 – 120 %	PFB
G3-VOA-1	1,1,2,2-Tetrachloroethane	0.91	1.0	14 %	67 – 125 %	DCB
G3-VOA-1	1,1,2-Trichloroethane	0.72	1.0	10 %	80 – 120 %	DFB
G3-VOA-1	1,1-Dichloroethane	0.48	1.0	10 %	77 – 122 %	PFB
G3-VOA-1	1,1-Dichloroethene	0.85	1.0	10 %	80 – 120 %	PFB
G3-VOA-1	1,2,4-Trichlorobenzene	0.60	1.0	10 %	80 – 120 %	DCB
G3-VOA-1	1,2-Dichloroethane	0.47	1.0	10 %	80 – 120 %	DFB
G3-VOA-1	1,2-Dichlorobenzene	0.67	1.0	10 %	80 – 120 %	DCB
G3-VOA-1	1,2-Dibromo-3-chloropropane	1.0	1.0	20 %	61 – 120 %	DCB
G3-VOA-1	1,2-Dichloropropane	0.53	1.0	10 %	80 – 120 %	DFB
G3-VOA-1	1,3-Dichlorobenzene	0.54	1.0	10 %	80 – 120 %	DCB
G3-VOA-1	1,4-Dichlorobenzene	0.39	1.0	40 %	80 – 120 %	DCB
G3-VOA-1	2-butanone	2.4	5.0	20 %	40 – 160 %	CB
G3-VOA-1	2-hexanone	1.8	5.0	20 %	40 –160 %	DFB
G3-VOA-1	4-methyl-2-pentanone	1.3	5.0	20 %	77 – 120 %	DFB
G3-VOA-1	Acetone	4.0	5.0	20 %	32 – 110 %	CB
G3-VOA-1	Benzene	0.48	1.0	10 %	78 – 122 %	DFB
G3-VOA-1	Bromodichloromethane	0.61	1.0	10 %	80 – 120 %	DFB
G3-VOA-1	Bromoform	0.70	1.0	20 %	64 – 124 %	CB
G3-VOA-1	Bromomethane	0.71	1.0	14 %	48 – 130 %	PFB
G3-VOA-1	Carbon Disulfide	0.50	1.0	20 %	64 – 128 %	PFB
G3-VOA-1	Carbon Tetrachloride	0.73	1.0	11 %	80 – 120 %	DFB
G3-VOA-1	Chlorobenzene	0.55	1.0	10 %	80 – 120 %	CB
G3-VOA-1	Dibromochloromethane	0.43	1.0	10 %	76 – 120 %	CB
G3-VOA-1	Chloroethane	0.57	1.0	10 %	67 – 121 %	PFB
G3-VOA-1	Chloroform	0.75	1.0	10 %	80 –120 %	PFB
G3-VOA-1	Chloromethane	0.62	1.0	20 %	30 – 136 %	PFB
G3-VOA-1	cis-1,2-Dichloroethene	0.73	1.0	20 %	80 – 120 %	PFB
G3-VOA-1	cis-1,3-Dichloropropene	0.56	1.0	10 %	80 – 120 %	DFB
G3-VOA-1	Dichlorodifluoromethane	0.68	1.0	20 %	3 – 160 %	PFB
G3-VOA-1	Ethylbenzene	0.43	1.0	10 %	80 – 120 %	CB
G3-VOA-1	Isopropylbenzene	0.43	1.0	20 %	80 – 120 %	DCB
G3-VOA-1	Methyl-tert-butyl ether	0.67	1.0	20 %	77 – 113 %	PFB
G3-VOA-1	Methyl acetate	2.6	5.0	30 %	70 – 130 %	CB
G3-VOA-1	Methyl cyclohexane	2.7	5.0	30 %	70 – 130 %	
G3-VOA-1	Methylene chloride	0.85	1.0	30 %	70 – 130 %	PFB
G3-VOA-1	Styrene	0.43	1.0	10 %	80 – 120 %	CB
G3-VOA-1	Tetrachloroethene	0.57	1.0	10 %	85 – 122 %	CB
G3-VOA-1	Toluene	0.47	1.0	10 %	80 – 120 %	DFB
G3-VOA-1	trans-1,2-Dichloroethene	0.79	1.0	10 %	80 – 120 %	PFB
G3-VOA-1	trans-1,3-Dichloropropene	0.51	1.0	10 %	80 – 120 %	DFB
G3-VOA-1	Trichloroethene	0.89	1.0	10 %	80 – 120 %	DFB
G3-VOA-1	Trichlorofluoromethane	0.52	1.0	10 %	80 – 124 %	PFB
G3-VOA-1	Vinyl Chloride	0.18	1.0	20 %	53 – 131 %	PFB

Table 3
LFRPD Quality Control Acceptance Criteria

Method	Analyte	Detection Limit (ug/L)	Reporting Limit (ug/L)	Precision Water (% RPD)	Accuracy Water (% R)	Assoc. Is
G3-VOA-1	Xylenes, total	1.5	3.0	10 %	80 – 120 %	CB
G3-VOA-1	***Surrogates:***				**RECOVERY LIMITS**	
G3-VOA-1	Dibromofluoromethane				61 – 136 %	
G3-VOA-1	Toluene-D8				63 – 140 %	
G3-VOA-1	4-Bromofluorobenzene				55 – 138 %	
G3-VOA-1						
G3-VOA-1	***Internal Standards:***	ACRONYM				
G3-VOA-1	1,4-Difluorobenzene	DFB				
G3-VOA-1	Pentafluorobenzene	PFB				
G3-VOA-1	Chlorobenzene-D5	CB				
G3-VOA-1	1,4-Dichlorobenzene-D4	DCB				

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
G3-VOA-1	All volatiles	6point initial calibration for all analytes (ICAL)	Initial calibration prior to sample analysis	SPCCs average RF meet criteria[a],. % RSD for RFs for CCCs ≤ 30 %, % RSD all others ≤ 15 % and one option below	Correct problem, then repeat initial calibration
G3-VOA-1	All volatiles	6point initial calibration for all analytes (ICAL)		*Option 1 linear*— Mean RSD for all analytes ≤ 15 % with no individual analyte RSD > 30 %	
G3-VOA-1	All volatiles	6 point initial calibration for all analytes (ICAL)		*Option 2 linear*—least squares regression r > 0.995	
G3-VOA-1	All volatiles	6 point initial calibration for all analytes (ICAL)		*Option 3 nonlinear*— curve coefficient ≥ 0.990 (6 points will be used for second order; 7 points will be used for third order)	
G3-VOA-1	All volatiles	Retention time window calculated for each analyte	Each sample	Relative retention time (RRT) of the analyte within ± 0.06 RRT units of the RRT	Correct problem, then reanalyze all samples analyzed since the last retention time check

Table 3
LFRPD Quality Control Acceptance Criteria

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
G3-VOA-1	All volatiles	Calibration verification (CCAL)	Daily, before sample analysis and every 12 hours of analysis time	SPCCs RF meet criteria[a]; and CCCs ≤ 20 % difference (when using RFs) or drift (when using least squares regression or nonlinear calibration)	Correct problem, then repeat initial calibration. Repeat entire calibration or just the calibration for the analyte(s) that fails.
G3-VOA-1	All volatiles	Calibration verification (CCAL)		All calibration analytes within ± 20 % of expected value	Correct problem, then reanalyze all samples analyzed since the last acceptable calibration check
G3-VOA-1	1,4-Difluorobenzene, Pentafluorobenzene Chlorobenzene-D5, 1,4-Dichlorobenzene-D4	ISs	Immediately after or during data acquisition for each sample	Retention time ± 30 seconds from retention time of the mid-point standard in the ICAL EICP area within –50 % to +100 % of ICAL mid-point standard.	Inspect mass spectrometer and GC for malfunctions; perform mandatory reanalysis of samples analyzed while system was mal-functioning
G3-VOA-1	All volatiles	Method blank	One per analytical batch of 20 or less samples	No analytes detected > MDL	Correct problem, then repeat prep and analysis of method blank and all samples processed with the contaminated blank
G3-VOA-1	All volatiles	Blind duplicate submitted by RETEC	1 from each OU	< 20 % RPD	Qualify existing data as estimated, examine other datapoints, may resample

Table 3
LFRPD Quality Control Acceptance Criteria

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
G3-VOA-1	All volatiles	LCS/LCSD for all analytes	One LCS/LCSD per analytical batch of 20 or less samples	Recovery: see Table 5 RPD: see Table 5	Correct problem, then repeat prep and analysis of LCS and all samples in the affected analytical batch
G3-VOA-1	All volatiles	MS/MSD	One MS/MSD per every 20 project samples per matrix	Recovery: see Precision limits RPD: see Accuracy limits	None, Qualify with "N" if both recoveries out, "MS" if one out. Qualify with "*" if RPD out
G3-VOA-1	All volatiles	Check of mass spectral ion intensities using BFB	Prior to initial calibration and calibration verification	G3-VOA-1 Table 1 limits All samples run within 12 hours of a valid tune	Retune instrument and verify Reanalyze samples within 12 hour of tune
G3-VOA-1	Dibromofluoromethane, Toluene-D8, 4-Bromofluorobenzene	Surrogate spike recovery	Every sample, spiked sample, standard, and method blank	Dibromofluoro-methane: 61 – 136 % Toluene-D8: 63 – 140 % 4-Bromofluoro-benzene: 55 – 138 %	Correct problem, then re-extract and re-analyze sample

$\underline{\geq}$ 0.10 for Bromoform, chloromethane, 1,1-dichloroethane, and $\underline{\geq}$ 0.30 for chlorobenzene, 1,1,2,2-tetrachloroethane

Table 3
LFRPD Quality Control Acceptance Criteria

Quality Control Acceptance Criteria for PAH Analysis in Leachate

Source: En Chem SOP SVOA-37

Method	Analyte	Detection Limit (ug/L)	Reporting Limit (ug/L)	Precision Water (% RPD)	Accuracy Water (% R)	Assoc. Is
SVOA-37	Acenaphthylene	2.34	10	20 %	75 - 107	ACE
SVOA-37	Acenaphthene	1.92	10	20 %	77 - 105	ACE
SVOA-37	Anthracene	1.99	10	20 %	72 - 118	PHN
SVOA-37	Benz[a]anthracene	2.47	10	20 %	59 - 135	CHY
SVOA-37	Benzo[a]pyrene	2.93	10	20 %	68 - 128	PRY
SVOA-37	Benzo[g,h,i]perylene	3.66	10	20 %	67 - 126	PRY
SVOA-37	Benzo(b)fluoranthene	3.17	10	20 %	73 - 117	PRY
SVOA-37	Benzo(k)fluoranthene	2.56	10	20 %	57 - 139	PRY
SVOA-37	Chrysene	2.35	10	20 %	68 - 123	CHY
SVOA-37	Dibenz[a,h]anthracene	3.32	10	20 %	54 - 146	PRY
SVOA-37	Fluoranthene	2.29	10	20 %	71 - 117	PHN
SVOA-37	Fluorene	2.08	10	20 %	67 - 122	ACE
SVOA-37	Indeno[1,2,3-c,d] pyrene	3.7	10	20 %	58 - 138	PRY
SVOA-37	Naphthalene	2.82	10	20 %	67 - 111	NAP
SVOA-37	Phenanthrene	2.3	10	20 %	74 - 113	PHN
SVOA-37	Pyrene	2.59	10	20 %	72 - 117	CHY
SVOA-37	*Surrogates:*	ACRONYM			Recovery Limits	
SVOA-37	2,4,6-Tribromophenol	TBP			29 - 148	
SVOA-37	2-Fluorobiphenyl	2FP			53 - 131	
SVOA-37	Nitrobenzene-D5	NIT			57 - 115	
SVOA-37	Phenol-D5	PHE			18 - 47	
SVOA-37	Terphenyl-D14	TER			30 - 151	
SVOA-37	*Internal Standards:*	ACRONYM				
SVOA-37	Naphthalene-D8	NAP				
SVOA-37	Acenaphthene-D8	ACE				
SVOA-37	Phenanthrene-D10	PHN				
SVOA-37	Chrysene-D12	CHY				
SVOA-37	Perylene-D12	PRY				

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
SVOA-37	All PAHs	Minimum 5 point initial calibration for all analytes (ICAL)	Initial calibration prior to sample analysis	% RSD for RFs for CCCs ≤ 30%, all others % RSD ≤ 15 % and one option below	Correct problem, then repeat initial calibration
SVOA-37	All PAHs	Minimum 5 point initial calibration for all analytes (ICAL)	Initial calibration prior to sample analysis	*Option 1 linear*— Mean RSD for all analytes ≤ 15% with no individual analyte RSD > 30%	

Table 3
LFRPD Quality Control Acceptance Criteria

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
SVOA-37	All PAHs	Minimum 5 point initial calibration for all analytes (ICAL)	Initial calibration prior to sample analysis	*Option 2 linear*—least squares regression $r > 0.99$	
SVOA-37	All PAHs	Minimum 5 point initial calibration for all analytes (ICAL)	Initial calibration prior to sample analysis	*Option 3 nonlinear*—curve coefficient ≥ 0.990 (6 points will be used for second order; 7 points will be used for third order)	
SVOA-37	All PAHs	Second-source calibration verification (ICV)	Once per five-point initial calibration before sample analysis	All analytes within $\pm$ 20% of expected value	Correct problem, then repeat initial calibration
SVOA-37	All PAHs	Retention time window calculated for each analyte	Each sample	Relative retention time (RRT) of the analyte within $\pm$ 0.06 RRT units of the RRT	Correct problem, then reanalyze all samples analyzed since the last retention time check
SVOA-37	All PAHs	Calibration verification (CCAL)	Daily, before sample analysis and every 12 hours of analysis time	CCCs $\leq$ 20% difference (when using RFs) or drift (when using least squares regression or nonlinear calibration)	Correct problem, then repeat initial calibration
SVOA-37	All PAHs	Calibration verification (CCAL)	Daily, before sample analysis and every 12 hours of analysis time	All calibration analytes within $\pm$ 20% of expected value	Correct problem, then repeat initial calibration
SVOA-37	Naphthalene-D8, Acenaphthene-D8, Phenanthrene-D10, Chrysene-D12, Perylene-D12	ISs	Immediately after or during data acquisition for each sample	Retention time $\pm$ 30 seconds from retention time of the mid-point standard in the ICAL. EICP area within –50% to +100% of ICAL mid-point standard.	Inspect MS and GC for malfunctions; perform mandatory reanalysis of samples analyzed while system was malfunctioning

Table 3
LFRPD Quality Control Acceptance Criteria

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
SVOA-37	All PAHs	Method blank	One per analytical batch of 20 or less samples	No analytes detected ≥ RL Must meet surrogate recovery limits for all surrogates; and < 5 % sample concentration	Correct problem, then repeat prep and analysis of method blank and all samples processed with the contaminated blank
SVOA-37	All PAHs	Blind duplicate submitted by RETEC	1 from each OU	< 20 % RPD	Qualify existing data as estimated, examine other datapoints, may resample
SVOA-37	All PAHs	LCS for all analytes	One per analytical batch of 20 or less samples	See Table 5 limits, 2 sporadic failures allowed	Correct problem, then repeat prep and analysis of LCS and all samples in the affected analytical batch, if reanalysis not possible, qualify with "&"
SVOA-37	All PAHs	MS/MSD	One MS/MSD per analytical batch of 20 or less samples of a matrix	Recovery: see Precision limits RPD: see Accuracy limits, 2 sporadic failures allowed	None, Qualify with "N" if both recoveries out, "MS" if one out. Qualify with "*" if RPD out
SVOA-37	All PAHs	Check of mass spectral ion intensities using DFTPP	Prior to initial calibration and calibration verification	SVOA-37 Appendix D limits All samples run within 12 hours of a valid tune	Retune instrument and verify Reanalyze samples within 12 hour of tune
SVOA-37	All PAHs	Peak tailing factor	Daily with DFTPP	Benzidine < 3.0 Pentachloro-phenol < 5.0	Clean injection port, replace liner/insert/seal, cut 6-12" column. If tailing still not in limits, replace column.
SVOA-37	All PAHs	DDTdegradation	Daily with DFTPP	DDT to DDE/DDD ≤ 20 %	Clean injection port, replace liner/insert/seal, cut 6-12" column.

Table 3
LFRPD Quality Control Acceptance Criteria

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
SVOA-37	2,4,6-Tribromophenol, 2-Fluorobiphenyl, Nitrobenzene-D5, Phenol-D5, Terphenyl-D14	Surrogate spike	Every sample, spiked sample, standard, and method blank	SVOA-37 Appendix E limits, 2 sporadic failures allowed	Correct problem, then re-extract and re-analyze sample

Quality Control Acceptance Criteria for Metals and Hardness Analysis in Filter Cake Column Test Leachate

Source: En Chem SOP MET-27

SOP #	Analyte	Detection Limit	Reporting Limit	Precision Water (% RPD)	Accuracy Water (% R)
MET-27	Hardness (calculated from Ca, Mg)	NA	5.0 mg/L	< 20 % RPD	75 - 125 %
MET-27	Iron	3.4 ug/L	150 ug/L	< 20 % RPD	75 - 125 %
MET-27	Zinc	2.1 ug/L	20 ug/L	< 20 % RPD	75 - 125 %
MET-27	Manganese	0.78 ug/L	2.0 ug/L	< 20 % RPD	75 - 125 %
MET-27	Lead	1.4 ug/L	10 ug/L	< 20 % RPD	75 - 125 %
MET-27	cadmium	0.43 ug/L	3.0 ug/L	< 20 % RPD	75 - 125 %

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
MET-27	all	Initial calibration (minimum 1 standard and a blank)	Daily initial calibration prior to sample analysis	N/A	N/A
MET-27	all	Second-source calibration check standard (ICV)	Once daily immediately after calibration	Analyte within ± 10% of expected value and RSD of replicate integrations < 5%	Correct problem, then repeat initial calibration verification
MET-27	all	Initial calibration blank (ICB)	After every calibration verification	Absolute value ≤ 3 X IDL . If 3 X IDL > RL, use RL, if 3 X IDL < 0.10RL, use 0.10RL	Correct problem, then repeat initial calibration verification.
MET-27	all	Calibration verification (CCV)	After every 10 samples and at the end of the analysis sequence	All analyte(s) within ± 10% of expected value and RSD of replicate integrations < 5%	Repeat calibration and reanalyze all samples since last successful calibration verification.

Table 3
LFRPD Quality Control Acceptance Criteria

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
MET-27	all	Continuing Calibration blank (CCB)	After every CCV	Absolute value $\leq$ 3 X IDL. If 3 X IDL > RL, use RL, if 3 X IDL < 0.10RL, use 0.10RL	Correct problem, then analyze calibration blank and previous 10 samples only if CCB < 0.10 sample level
MET-27	all	Method blank	One per analytical batch of 20 or less samples	No analytes detected $\geq$ RL	Correct problem, then repeat prep and analysis of method blank and all samples processed with the contaminated blank
MET-27	all	Interference check solution (ICS)	At the beginning of an analytical run of 20 or less samples	Within $\pm$ 20% of expected value	Terminate analysis, correct problem, reanalyze ICS, reanalyze all affected samples
MET-27	all	LCS/LCSD for the analyte	One LCS/LCSD per analytical batch of 20 or less samples	Recovery: 90 – 110 % RPD: < 20 %	Correct problem, then repeat prep and analysis of LCS and all samples in the affected analytical batch, if reanalysis not possible, qualify with "&"
MET-27	all	Serial dilution test	Each new sample matrix , one per analytical batch of 20 or less samples of same matrix	1:5 dilution must agree within $\pm$ 10% of the original determination	Perform post digestion spike addition, qualify with "E" if levels > 50 X IDL
MET-27	all	Post digestion spike addition	One per analytical batch of 20 or less samples	Recovery within 75–125% of expected results	Dilute sample and do post spike on diluted sample, repeat until acceptable, note in narrative
MET-27	all	MS/MSD	One MS/MSD per every 20 project samples per matrix	Recovery: 75 – 125 % RPD: < 20 % If level < 5 X RL, RPD limit = $\pm$ RL	Qualify with "N" if recovery out, then do post digest spike. Qualify with "*" if RPD out

Table 3
LFRPD Quality Control Acceptance Criteria

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
MET-27	all	Blind duplicate submitted by RETEC	1 from each OU	< 20 % RPD	Qualify existing data as estimated, examine other datapoints, may resample
MET-27	all	Interference check samples (ICS)	daily	80 – 120 % true value and Level < ± RL when true value = 0	Investigate, analyze interfering metals separately to determine which one is out
MET-27	all	Internal standard (Y) response	Every field and QC sample	30 – 120 % of ICB counts	Reanalyze

Quality Control Acceptance Criteria for Mercury Analysis in Filter Cake Column Test Leachate

Source: En Chem SOP MET-30

SOP #	Analyte	Detection Limit (ug/L)	Reporting Limit (ug/L)	Precision Water (% RPD)	Accuracy Water (% R)
MET-30	Mercury	0.088 ug/L	0.2 ug/L	< 20 % RPD	75 – 125 %

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
MET-30	Mercury	Initial multipoint calibration (minimum 5 standards and a blank)	Daily initial calibration prior to sample analysis	Correlation coefficient ≥ 0.995 for linear regression	Correct problem, then repeat initial calibration
MET-30	Mercury	Second-source calibration check standard (ICV)	Once per initial daily multipoint calibration, immediately after	Analyte within ± 10% of expected value	Correct problem, then repeat initial calibration verification.
MET-30	Mercury	Initial calibration blank (ICB)	Once per initial daily multipoint calibration, before sample analysis	Absolute value ≤ 0.20 ug/L	Correct problem, then repeat initial calibration verification.

Table 3
LFRPD Quality Control Acceptance Criteria

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
MET-30	Mercury	Calibration verification (CCV)	After every 10 samples and at the end of the analysis sequence	± 10% of expected value	Correct problem, then repeat calibration verification and reanalyze all samples since last successful calibration verification
MET-30	Mercury	Continuing Calibration blank (CCB)	After every CCV	Absolute value ≤ 0.20 ug/L	Correct problem, then repeat calibration verification and reanalyze all samples since last successful calibration verification.
MET-30	Mercury	Method blank	One per analytical batch of 20 or less samples	Absolute value < 0.088 ug/L	Correct problem, then repeat prep and analysis of method blank and all samples processed with the contaminated blank
MET-30	Mercury	LCS for the analyte	One LCS per analytical batch of 20 or less samples	90 – 110 %	Correct problem, then repeat prep and analysis of LCS and all samples in the affected analytical batch
MET-30	Mercury	MS/MSD	One MS/MSD per every 20 project samples per matrix	Recovery: 75 – 125 % RPD: < 20 %	Qualify with "N" if recovery out, then do post digest spike. Qualify with "*" if RPD out
MET-30	Mercury	Post Digest Spike	As needed when MS/MSD fails	75 – 125 %	Dilute sample and do post spike on diluted sample, repeat until acceptable, note in narrative.

Table 3
LFRPD Quality Control Acceptance Criteria

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
MET-30	Mercury	Blind duplicate submitted by RETEC	1 from each OU	< 20 % RPD	Qualify existing data as estimated, examine other datapoints, may resample

Quality Control Acceptance Criteria for Sediment Chemical Analysis

Source: En Chem SOPs as listed

Method	Analyte	Detection Limit	Reporting Limit	Precision Soil (% RPD)	Accuracy Soil (% R)
WCM-9, 18	TOC	91 mg/kg dry wt	500 mg/kg dry wt	26 %	86 - 130 %
LAB-16	% solids	NA	0.1 %	14 %	NA
K-SVO-77	% solids (air dried sample)	NA	0.1 %	14 %	NA
K-SVO-77	Aroclor 1016	22 ug/kg dry wt	50 ug/kg dry wt	30 %	65 – 135 %
K-SVO-77	Arcolor 1221	22 ug/kg dry wt	50 ug/kg dry wt	30 %	65 – 135 %
K-SVO-77	Aroclor 1232	22 ug/kg dry wt	50 ug/kg dry wt	30 %	65 – 135 %
K-SVO-77	Aroclor 1242	22 ug/kg dry wt	50 ug/kg dry wt	30 %	65 – 135 %
K-SVO-77	Aroclor 1248	22 ug/kg dry wt	50 ug/kg dry wt	30 %	65 – 135 %
K-SVO-77	Aroclor 1254	22 ug/kg dry wt	50 ug/kg dry wt	30 %	65 – 135 %
K-SVO-77	Aroclor 1260	22 ug/kg dry wt	50 ug/kg dry wt	30 %	65 – 135 %
IMMU-1, 2, 3	Aroclor 1242	NA	500 ug/kg	30 %	53-126%

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
WCM-9, 18	TOC	Update calibration factor with 3 standards	Initially and as needed when calibration failures occur	See instrument manual	Correct problem, then repeat initial calibration
WCM-9, 18	TOC	Calibration check standard ICV	Daily	90 – 110 %	Correct problem, then repeat initial calibration check standards
WCM-9, 18	TOC	Initial calibration blank (ICB)	Daily	Absolute value < EQL	Correct problem, then repeat initial calibration check standards

Table 3
LFRPD Quality Control Acceptance Criteria

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
WCM-9, 18	TOC	Calibration verification (CCV)	After every 10 samples and at the end of the analysis sequence	± 10% of expected value	Correct problem, then repeat calibration check standard and reanalyze all samples since last successful calibration check standard
WCM-9, 18	TOC	Continuing Calibration blank (CCB)	After every CCV	Absolute value < EQL	Correct problem, then repeat prep and analysis of CCB and all samples processed with the contaminated blank
WCM-9, 18	TOC	Method blank (MB)	One per analytical batch of 20 or less samples	Absolute value < EQL, if sample level > 20 X MB, no action. Flag if between the MDL and EQL.	Correct problem, then repeat prep and analysis of method blank and all samples processed with the contaminated blank. If MB > MDL < RL, qualify sample levels < 20 X MB with "A"
WCM-9, 18	TOC	Sample quadruplicate	Every sample	% RSD < 20 % if level > 5 X EQL	Repeat analysis, dilute, repeat until acceptable.
WCM-9, 18	TOC	LCS	One LCS per analytical batch of 20 or less samples	80 -120%	Correct problem, then repeat prep and analysis of LCS and all samples in the affected analytical batch
WCM-9, 18	TOC	MS/MSD	One MS/MSD per every 20 project samples per matrix	Recovery: 35 – 155 % RPD: < 26 %	Qualify with "N" if either recovery is out, Qualify with "*" if RPD out

Table 3
LFRPD Quality Control Acceptance Criteria

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
WCM-9, 18	TOC	Collocated sediment core sample	Submitted blind to lab	< 30 % RPD	RETEC may request analysis of additional aliquot(s), data qualified as estimated during validation
LAB-16	% solids	Lab duplicate	One per analytical batch of 20 or less samples	< 14 % RPD	Qualify with "*"
LAB-16	% solids	Collocated sediment core sample	Submitted blind to lab	< 30 % RPD	RETEC may request analysis of additional aliquot(s), data qualified as estimated during validation
K-SVO-77 K-SVO-79	% solids (air dried)	Lab duplicate	One per analytical batch of 20 or less samples	< 30% RPD	Qualify with "*"
K-SVO-77 K-SVO-79	% solids (air dried)	Collocated sediment core sample	Submitted blind to lab	< 30 % RPD	RETEC may request analysis of additional aliquot(s), data qualified as estimated during validation
K-SVO-77	Aroclor 1242, 1254	Five-point initial calibration (ICAL)	Initial calibration prior to sample analysis	Calibration factor of each peak $\leq$ 20 % RSD	Correct problem, then repeat initial calibration
K-SVO-77	Aroclors 1016/1260, 1221, 1232, 1248	Five-point initial calibration only if detected in sample(s) 3 point for 1221 (ICAL)	Initial calibration prior to sample analysis	Calibration factor of each peak $\leq$ 20 % RSD	Correct problem, then repeat initial calibration
K-SVO-77	Aroclors 1016/1260, 1221, 1232, 1248	One point midrange calibration standard	With each Aroclor 1242 and 1254 initial calibration	Calibration factor of each peak $\leq$ 20 % RSD	Correct problem, then repeat initial calibration
K-SVO-77	All Aroclors	Qualitative match for Aroclor identification	Every sample	Minimum 5 peak match for all Aroclors except Aroclor 1221 (3 peak match)	None, do not report as detected Aroclor
K-SVO-77	All Aroclors	Confirmation analysis on second column	Every sample	Minimum 5 peak match for all Aroclors except Aroclor 1221 (3 peak match)	None, do not report as detected Aroclor

Table 3
LFRPD Quality Control Acceptance Criteria

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
K-SVO-77	All Aroclors	Retention time window	Each calibration verification	ICAL mean RT $\pm$ 0.03 minutes	Correct problem, then reanalyze all samples analyzed since the last retention time check
K-SVO-77	Aroclors 1242, 1254	Calibration verification. Alternate standards	After every 10 samples	Average RF of $\geq$ 5 peaks $\leq$ 15 % difference from ICAL mean RF	Correct problem, then repeat initial calibration verification and reanalyze all samples since last successful calibration verification
K-SVO-77	Aroclors 1242 or 1254	Ending calibration verification	After all samples analyzed	Average RF of $\geq$ 5 peaks $\leq$ 15 % difference from ICAL mean RF	If sensitivity increased > 15 %, no reanalysis of undetected samples needed. If sensitivity decreased > 15 %, reanalyze detected samples
K-SVO-77 K-SVO-79	All Aroclors	Method blank (MB)	One per analytical batch of 20 samples or less	No analytes detected $\geq$ RL	Correct problem, then repeat prep and analysis of method blank and all samples with detects < 20 X MB processed with the contaminated blank
K-SVO-77 K-SVO-79	Aroclors 1242	LCS (level at 5 X RL)	One LCS per analytical batch of 20 samples or less	65 – 135 %	Assess all other batch QC for same bias, if consistent bias present, repeat prep and analysis of LCS and all samples in the affected analytical batch

Table 3
LFRPD Quality Control Acceptance Criteria

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
K-SVO-77 K-SVO-79	All Aroclors	Surrogate spikes (TMX, DCB)	Every sample, spiked sample, standard, and method blank	60 – 140 %	If both TCX and DCB out of limit, re-extract and re-analyze sample
K-SVO-77 K-SVO-79	Aroclor 1242	MS/MSD (level at 10 – 100 X RL)	One MS/MSD per every 20 project samples	65 – 135 %	If both MS and MSD recoveries out of limit, qualify data and note in case narrative suspected matrix problem
K-SVO-77 K-SVO-79	All Aroclors	Collocated sediment core sample	Submitted blind to lab	< 30 % RPD	RETEC may request analysis of additional aliquot(s), data qualified as estimated during validation
IMMU-1, 2, 3	Aroclor 1242	Initial 5 point calibration	Daily	Slope and ED50 must be 70 – 130 % of average values of previous 5 daily calibration curves	Correct problem, then repeat initial calibration
IMMU-1, 2, 3	Aroclor 1242,	Calibration check @ ED50	One per analytical batch of 20 samples or less	Check standard at 200 ug/L (equivalent to 1 mg/kg sediment conc.) must be 80 – 120 % of this value	Correct problem, then repeat initial calibration verification and reanalyze all samples since last successful calibration verification
IMMU-1, 2, 3	Aroclor 1242,	Method blank-Ottawa sand	One per analytical batch of 20 samples or less	< RL	Correct problem, then repeat prep and analysis of method blank and all samples with detects < 20 X MB processed with the contaminated blank
IMMU-1, 2, 3	Aroclor 1242,	Lab duplicate	One per analytical batch of 20 samples or less	< 30 % RPD	Qualify data and note in case narrative, designate for K-SVO-77 analysis

Table 3
LFRPD Quality Control Acceptance Criteria

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
IMMU-1, 2, 3	Aroclor 1242,	Fox Control Sediment	Daily	Within 99 % confidence limit set by regression analysis between SW846 8082 and Hybrizyme data	Reanalyze all associated samples
IMMU-1, 2, 3	Aroclor 1242,	MS/MSD	One per analytical batch of 20 samples or less	53-126 % advisory until more data collected	If both MS and MSD recoveries out of limit, qualify data and note in case narrative suspected matrix problem, designate for K-SVO-77 analysis
IMMU-1, 2, 3	All Aroclors	Collocated sediment core sample	Submitted blind to lab	< 30 % RPD	RETEC may request analysis of additional aliquot(s), data qualified as estimated during validation

Quality Control Acceptance Criteria for Mineralogy in Sediment by XRF Analysis

Source: The Mineral Lab, 2003

SOP #	Analyte	Detection Limit (ppm)	Precision Soil (% RPD)	Accuracy Soil (% R)
proprietary	Sodium	500	5 – 10 %	5 – 10 %
proprietary	Magnesium	500	5 – 10 %	5 – 10 %
proprietary	Aluminum	200	5 – 10 %	5 – 10 %
proprietary	Silicon	200	5 – 10 %	5 – 10 %
proprietary	Phosphorus	500	5 – 10 %	5 – 10 %
proprietary	Sulfur	500	5 – 10 %	5 – 10 %
proprietary	Chlorine	200	5 – 10 %	5 – 10 %
proprietary	Potassium	100	5 – 10 %	5 – 10 %
proprietary	Calcium	100	5 – 10 %	5 – 10 %
proprietary	Titanium	100	5 – 10 %	5 – 10 %
proprietary	Manganese	100	5 – 10 %	5 – 10 %
proprietary	Iron	100	5 – 10 %	5 – 10 %
proprietary	Barium	100	5 – 10 %	5 – 10 %
proprietary	Vanadium	10	10 –15 %	10 –15 %
proprietary	Chromium	10	10 –15 %	10 –15 %
proprietary	Cobalt	10	10 –15 %	10 –15 %
proprietary	Nickel	10	10 –15 %	10 –15 %
proprietary	Copper	10	10 –15 %	10 –15 %
proprietary	Zinc	10	10 –15 %	10 –15 %
proprietary	Arsenic	20	10 –15 %	10 –15 %
proprietary	Tin	50	10 –15 %	10 –15 %

Table 3
LFRPD Quality Control Acceptance Criteria

SOP #	Analyte	Detection Limit (ppm)	Precision Soil (% RPD)	Accuracy Soil (% R)
proprietary	Rubidium	10	10 –15 %	10 –15 %
proprietary	Strontium	10	10 –15 %	10 –15 %
proprietary	Yttrium	10	10 –15 %	10 –15 %
proprietary	Zirconium	10	10 –15 %	10 –15 %
proprietary	Niobium	10	10 –15 %	10 –15 %
proprietary	Molybdenum	10	10 –15 %	10 –15 %
proprietary	Tungsten	10	10 –15 %	10 –15 %
proprietary	Lead	10	10 –15 %	10 –15 %
proprietary	Thorium	10	10 –15 %	10 –15 %
proprietary	Uranium	10	10 –15 %	10 –15 %

SOP#	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
proprietary	All elements	Initial Calibration	Follow manufacturer protocol	Follow manufacturer limits	Correct problem, then repeat initial calibration
proprietary	All elements	Calibration verification	Follow manufacturer protocol	Follow manufacturer limits	Correct problem, then repeat samples analyzed with noncompliant calibration
proprietary	All elements	Blind duplicate submitted by RETEC	1 from each OU	< 20 % RPD	Qualify existing data as estimated, examine other datapoints, may resample
proprietary	Major-minor elements	Lab duplicate	One per analytical batch of 20 or fewer samples	RPD < 10 % if levels > 2 X Detection Limit	Correct problem, then repeat prep and analysis of duplicate and all samples processed with the out of limit lab duplicate
proprietary	Trace elements	Lab duplicate	One per analytical batch of 20 or fewer samples	RPD < 15 %, if levels > 2 X Detection Limit	Correct problem, then repeat prep and analysis of duplicate and all samples processed with the out of limit lab duplicate
proprietary	Major-minor elements	NIST reference	One per analytical batch of 20 or fewer samples	Within NIST Certified limits	Correct problem, then repeat prep and analysis of NIST and all samples in the affected analytical batch

Table 3
LFRPD Quality Control Acceptance Criteria

SOP#	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
proprietary	Trace elements	NIST reference	One per analytical batch of 20 or fewer samples	Within NIST Certified limits	Correct problem, then repeat prep and analysis of NIST and all samples in the affected analytical batch

Quality Control Acceptance Criteria for Sediment Geotechnical and Physical Analyses

Source: CQM, Inc.

SOP #	Analyte	Detection Limit	Precision Soil (% RPD)	Accuracy Soil (% R)
Con Mat 1-5	Grain size	NA	Not established	Sample fractions sum within ± 0.3 % original weight
Con Mat 2-7	Bulk density	NA	Not established	No reference sample available
Con Mat 1-7	Specific gravity	NA	Not established	No reference sample available
Con Mat 1-2	Percent solids	NA	Not established	No reference sample available
Con Mat 1-6	Atterberg Limits	NA	< 2 %	No reference sample available
Con Mat 2-2	Proctor test with 5.5 lb rammer	NA	Not established	No reference sample available
Con Mat 2-3	Proctor test with 10 lb rammer	NA	Not established	No reference sample available

SOP#	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Con Mat 1-5	Grain size	Blind duplicate submitted by RETEC	1 from each OU	< 20 % RPD	Qualify existing data as estimated, examine other datapoints, may resample
Con Mat 2-7	Bulk density	Blind duplicate submitted by RETEC	1 from each OU	< 20 % RPD	Qualify existing data as estimated, examine other datapoints, may resample

Table 3
LFRPD Quality Control Acceptance Criteria

SOP#	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Con Mat 1-7	Specific gravity	Blind duplicate submitted by RETEC	1 from each OU	< 20 % RPD	Qualify existing data as estimated, examine other datapoints, may resample
Con Mat 1-2	Percent solids	Blind duplicate submitted by RETEC	1 from each OU	< 20 % RPD	Qualify existing data as estimated, examine other datapoints, may resample
Con Mat 1-6	Atterberg Limits	Lab duplicate	Every sample	< 2 % RPD	Repeat test
Con Mat 1-6	Atterberg Limits	Blind duplicate submitted by RETEC	1 from each OU	< 20 % RPD	Qualify existing data as estimated, examine other datapoints, may resample
Con Mat 2-2	Proctor test	Blind duplicate submitted by RETEC	1 from each OU	< 20 % RPD	Qualify existing data as estimated, examine other datapoints, may resample
Con Mat 2-3	Proctor test	Blind duplicate submitted by RETEC	1 from each OU	< 20 % RPD	Qualify existing data as estimated, examine other datapoints, may resample

Quality Control Acceptance Criteria for Sediment Geotechnical and Physical Analyses

Source: SET, Inc. and ARI

SOP #	Analyte	Detection Limit	Precision Soil (% RPD)	Accuracy Soil (% R)
ASTM D4648-00	In field Vane shear test	NA	Not established	No reference sample available
ASTM D2850-95	Triaxial compression	NA	Not established	No reference sample available
ASTM D2166	Compressive strength	NA	Not established	No reference sample available

Table 3
LFRPD Quality Control Acceptance Criteria

SOP#	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
ASTM D4648-00	In field Vane shear test	Blind duplicate submitted by RETEC	1 from each OU	< 20 % RPD	Qualify existing data as estimated, examine other datapoints, may resample
ASTM D2850-95	Triaxial compression	Blind duplicate submitted by RETEC	1 from each OU	< 20 % RPD	Qualify existing data as estimated, examine other datapoints, may resample
ASTM D2166	Compressive strength	Blind duplicate submitted by RETEC	1 from each OU	< 20 % RPD	Qualify existing data as estimated, examine other datapoints, may resample

Table 4
Sample Preservation, Containers, and Holding Times

Name	Analytical SOP #s	Matrix	Container[a]	Preservation[b,c]	Minimum Sample Volume or Weight	Maximum Holding Time
COD	WCM-40	Filter cake column leachate	125 ml HDPE	4 °C, H_2SO_4 to pH < 2	50 ml	28 days
ammonia	WCM-25, WCM-58	Filter cake column leachate	1 liter HDPE	4 °C, H_2SO_4 to pH < 2	400 ml	28 days
DOC	WCM-2, WCM-18	Filtered Porewater, Filtered SBLT leachate	1 liter HDPE	4 °C, H_2SO_4 to pH < 2	500 ml	28 days
TOC	WCM-2, WCM-18	Porewater, SBLT leachate	1 liter HDPE	4 °C, H_2SO_4 to pH < 2	500 ml	28 days
BOD	G2-WCM-51	Filter cake column leachate	2 liters	4 °C	1 liter	
pH	618S	Filter cake column leachate	60 ml HDPE	None required	100 ml	Analyze immediately
conductivity	611S	Filter cake column leachate	250 ml HDPE	4 °C	100 ml	Analyze immediately
chloride	WCM-60	Filter cake column leachate	125 ml HDPE	4 °C	50 ml	28 days
sulfate	WCM-60	Filter cake column leachate	125 ml HDPE	4 °C	50 ml	28 days
mercury	MET-30	Filter cake column leachate	250 ml HDPE	4 °C, HNO_3 to pH < 2	100 ml	28 days
zinc, iron manganese, lead, cadmium, hardness	MET-45, MET-27, MET-29	Filter cake column leachate	250 ml HDPE	4 °C, HNO_3 to pH < 2,	100 ml	180 days
volatile organics	G3-VOA-1	Filter cake column leachate	2- 40 ml volatile vials, glass with Teflon lined septum	4 °C, HCl to pH < 2, no headspace	25 ml	14 days
PCBs	SVO-6, 52	pore water, SBLT leachate	1 liter amber glass, Teflon-lined cap	4 °C	1 liter	7 days until extraction and 40 days after extraction to analysis
PCB Congeners	MLA-007	Filter cake column leachate	1 liter amber glass, Teflon-lined cap	4 °C	1 liter	7 days until extraction and 40 days after extraction to analysis
PAHs	SVOA-1, 37	Filter cake column leachate	1 liter amber glass, Teflon-lined cap	4 °C	1 liter	7 days until extraction and 40 days after extraction to analysis
PCBs, % solids	SVO-26, 27, 57, K-SVO-77 and/or IMMU-1, 2, 3	sediment	1 quart freezer bag inside another	4 °C for transport, store frozen air dried samples stored at room temperature	20 grams air dried, ≥100 grams wet	14 days from thawing or collection to air drying and 40 days after extraction to analysis
TOC	WCM-9, 18	sediment	1 quart freezer bag inside another	4 °C for transport, store frozen air dried samples stored at room temperature	10 grams air dried, ≥ 50 grams wet	28 days from thawing or collection to air drying

Table 4
Sample Preservation, Containers, and Holding Times

Name	Analytical SOP #s	Matrix	Container[a]	Preservation[b,c]	Minimum Sample Volume or Weight	Maximum Holding Time
% solids	Con Mat 1-2	sediment	Undisturbed sample such as capped drive cylinder, caps duct taped to cylinder	ship/transport in orientation sampled, prevent bumping	20 grams – 50 Kg, depending on composition	Not established
Grain size	Con Mat 1-5	sediment	1 quart freezer bag inside another	none	20 –100 grams wet, 60 –95 grams air dried	Not established
Bulk unit weight	Con Mat 2-7	sediment	Undisturbed sample such as capped drive cylinder, caps duct taped to cylinder	ship/transport in orientation sampled, prevent bumping	Minimum volume 450 cc	Not established
Specific gravity	Con Mat 1-7	sediment	1 quart freezer bag inside another	none	10 – 25 grams	Not established
Atterberg limits	Con Mat 1-6	sediment	1 quart freezer bag inside another	none	200 grams?	Not established
vane shear test	ASTM D4648	In place method done in field	NA	NA	NA	NA
compressive strength	ARI ASTM D2166	Sediment or filter cake	Undisturbed sample such as capped drive cylinder, caps duct taped to cylinder	prevent bumping	cylinder ~ 1.3 in diameter , height : diameter ratio 2- 2.5	Not established
triaxial compression	ASTM D2850, ASTM 4767	Sediment or filter cake	Undisturbed sample such as capped drive cylinder, caps duct taped to cylinder	prevent bumping	cylinder ~ 1.3 in diameter , height : diameter ratio 2- 2.5	Not established
mineralogy	XRF	sediment	1 quart freezer bag inside another	none	5 grams 400 mesh material	Not established
Proctor test	Con Mat 2-2 or 2-3	filter cake	plastic container airtight lid	none	25 – 50 pounds	Not established
SBLT	ARI Sequential Batch Procedure	Sediment from potential cap areas	plastic container airtight lid	none	Enough sediment to provide 3 liters of leachate for chemical analysis	Not established
Column leaching by ASTM D4874	ASTM D4874	filter cake	plastic container airtight lid	none	5 kg	Not established

Table 5
Acceptance Limits for LCS/LCSD for Volatiles and PAHS

Parameter	LCS Recovery Limits	LCS % RPD Limits
Volatiles		
1,1 - Dichloroethane	70-130	0-40
1,1 - Dichloroethene	83-127	0-10
1,1,1 - Trichloroethane	70-130	0-40
1,1,2 - Trichloro - 1,2,2 - Trifluoroethane/1,1,2 - Trichlorotrifluoroethane	50-150	0-50
1,1,2 - Trichloroethane	70-130	0-40
1,1,2,2 - Tetrachloroethane	70-130	0-40
1,2 - Dibromo - 3 - Chloropropane	70-130	0-40
1,2 - Dibromoethane	70-130	0-40
1,2 - Dichlorobenzene	70-130	0-40
1,2 - Dichloroethane	70-130	0-40
1,2 - Dichloropropane	70-130	0-40
1,2,4 - Trichlorobenzene	70-130	0-40
1,3 - Dichlorobenzene	70-130	0-40
1,4 - Dichlorobenzene	70-130	0-40
2 - Butanone	70-130	0-40
2 - Hexanone	70-130	0-40
4 - Methyl - 2 - pentanone	70-130	0-40
Acetone	70-130	0-40
Benzene	79-122	0-11
Bromodichloromethane	70-130	0-40
Bromoform	70-130	0-40
Bromomethane	50-150	0-50
Carbon disulfide	70-130	0-40
Carbon tetrachloride	70-130	0-40
Chlorobenzene	89-114	0-10
Chlorodibromomethane / Dibromochloromethane	70-130	0-40
Chloroethane	50-150	0-50
Chloroform	70-130	0-40
Chloromethane	50-150	0-50
cis - 1,2 - Dichloroethene	70-130	0-40
cis - 1,3 - Dichloropropene	70-130	0-40
Dichlorodifluoromethane	50-150	0-50
Ethylbenzene	70-130	0-40
Isopropyl benzene	70-130	0-40
Methyl - tert - butyl - ether	70-130	0-40
Methyl Acetate	70-130	0-30
Methylcyclohexane	70-130	0-30
Methylene chloride	70-130	0-30
Styrene	70-130	0-40
Tetrachloroethene	70-130	0-40
Toluene	89-117	0-11
trans - 1,2 - Dichloroethene	70-130	0-40

Table 5
Acceptance Limits for LCS/LCSD for Volatiles and PAHS

Parameter	LCS Recovery Limits	LCS % RPD Limits
trans - 1,3 - Dichloropropene	70-130	0-40
Trichloroethene	84-118	0-12
Trichlorofluoromethane	50-150	0-50
Vinyl chloride	50-150	0-50
Xylene, total	70-130	0-40
PAHs		
Acenaphthene	72-109	0-20
Acenaphthylene	72-111	0-20
Anthracene	76-113	0-20
Benzo(a)anthracene	64-128	0-20
Benzo(a)pyrene	77-119	0-20
Benzo(b)fluoranthene	71-118	0-20
Benzo(g,h,i)perylene	67-126	0-20
Benzo(k)fluoranthene	68-120	0-20
Chrysene	64-122	0-20
Dibenzo(a,h)anthracene	67-129	0-20
Fluoranthene	73-114	0-20
Fluorene	60-129	0-20
Indeno(1,2,3-cd)pyrene	68-126	0-20
Naphthalene	69-105	0-20
Phenanthrene	73-113	0-20
Pyrene		

Figures

Figure 1 - Pre-Design Sampling Organization

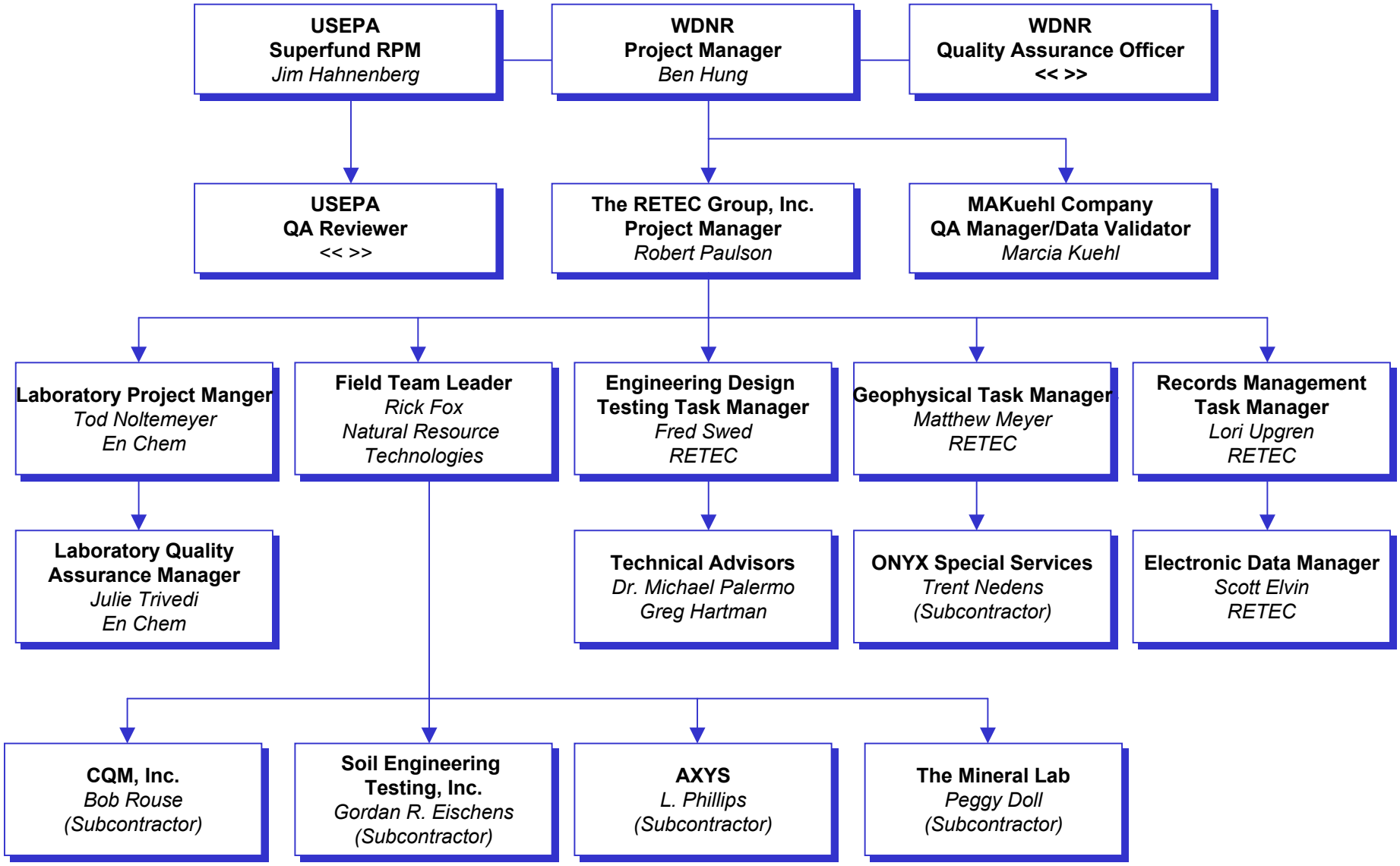

FIGURE 2
WORK BREAKDOWN & SCHEDULE
[including work for Survey Control and Topographic and Bathymetric Mapping
an Lower Fox River (CO.Sai.05954.a)]

ID	Task Name	Duration
1	***PRE-DESIGN ACTIVITIES***	*1 day?*
2	*DRAFT PLAN REVIEW*	*30 days*
3	*REVISE DOCUMENTS*	*60 days*
4		
5	***NOTICE TO PROCEED SAMPLING FOR DELINEATION, CAPPING AND ENGINEERING GEOTECHNICAL***	*1 day*
6	*MOBILIZATION SAMPLING FOR DELINEATION, CAPPING AND ENGINEERING GEOTECHNICAL*	*8 wks*
7		
8	NOTICE TO PROCEED SURVEY & BATHYMETRY -Survey Control and Topographic and Bathymetric Mapping	0 days
9		
10	SURVEY CONTROL (Survey Control and Topographic and Bathymetric Mapping TASK 100)	40 days
11	ACCESS AGREEMENTS	28 days
12	FIELD WORK	40 days
13		
14	GEOPHYSICAL SURVEYS (Survey Control and Topographic and Bathymetric MappingTASK 300)	144 days
15	OU1	61 days
16	SIDESCAN SONAR AND SUB-BOTTOM PROFILING	7 days
17	BATHYMETRY	21 days
18	DATA PROCESSING AND INTERPRETATION	30 days
19		
20	OU3	137 days
21	SIDESCAN SONAR AND SUB-BOTTOM PROFILING	7 days
22	BATHYMETRY	*21 days*
23	DATA PROCESSING AND INTERPRETATION	30 days
24		
25	**PCB DELINEATION OU3**	**170 days**
26	REVIEW EXISTING DATA - LOCATE CORES	1 wk
27	*SAMPLE COLLECTION/ VANE SHEAR (in capping areas)/ MSCL*	*20 wks*
28	*ANALYTICAL TESTING*	*21 wks*
29		
30	***PHASE 2***	*1 day?*
31		
32	**CAPPING GEOTECHNICAL OU3**	**25 days**
33	*REVIEW EXISTING DATA/LOCATION OF CORES*	*1 wk*
34	*SAMPLE COLLECTION/ VANE SHEAR*	*2 wks*
35	*TRIAXIAL*	*4 wks*
36	*SBLP*	*4 wks*
37	*POREWATER*	*4 wks*
38		
39	**ENGINEERING GEOTECHNICAL OU3**	**463 days?**
40	*REVIEW EXISTION DATA - LOCATE CORES*	*1 wk*
41	SAMPLE COLLECTION	20 days
42	*FILTRATE SAMPLES*	*4 wks*
43	*LEACHATE TESTING*	*4 wks*
44	*PRESS SAMPLES*	*4 wks*
45		
46	OU4	151 days
47	SIDESCAN SONAR AND SUB-BOTTOM PROFILING	7 days
48	BATHYMETRY	*21 days*
49	DATA PROCESSING AND INTERPRETATION	30 days
50		
51	**PCB DELINEATION OU4**	**379 days**
52	REVIEW EXISTING DATA - LOCATE CORES	1 wk
53	*SAMPLE COLLECTION/ VANE SHEAR (in capping areas)/ MSCL*	*47.6 wks*
54	*ANALYTICAL TESTING*	*48.8 wks*
55		
56	***PHASE 2***	*1 day?*
57		
58	**CAPPING GEOTECHNICAL OU4**	**25 days**
59	*REVIEW EXISTING DATA/LOCATION OF CORES*	*1 wk*
60	*SAMPLE COLLECTION/ VANE SHEAR*	*2 wks*
61	*TRIAXIAL*	*4 wks*
62	*SBLP*	*4 wks*
63	*POREWATER*	*4 wks*
64		
65	**ENGINEERING GEOTECHNICAL OU4**	**25 days**
66	*REVIEW EXISTION DATA - LOCATE CORES*	*1 wk*
67	*SAMPLE COLLECTION*	*2 wks*
68	*FILTRATE SAMPLES*	*4 wks*
69	*LEACHATE TESTING*	*4 wks*
70	*PRESS SAMPLES*	*4 wks*
71		
72	AERIAL PHOTOGRAPHY (Survey Control and Topographic and Bathymetric Mapping TASK 200)	75 days
73	DATA ACQUISITION	14 days
74	DATA PROCESSING AND INTERPRETATION	61 days
75		
76	MAPPING (Survey Control and Topographic and Bathymetric Mapping TASK 400)	152 days
77	OU1 BED ELEVATION CONTOURING	*16 days*
78	OU1 PRODUCTION	31 days
79		
80	OUS 3 AND 4 BED ELEVATION CONTOURING	*18 days*
81	OUS 3 AND 4 PRODUCTION	40 days

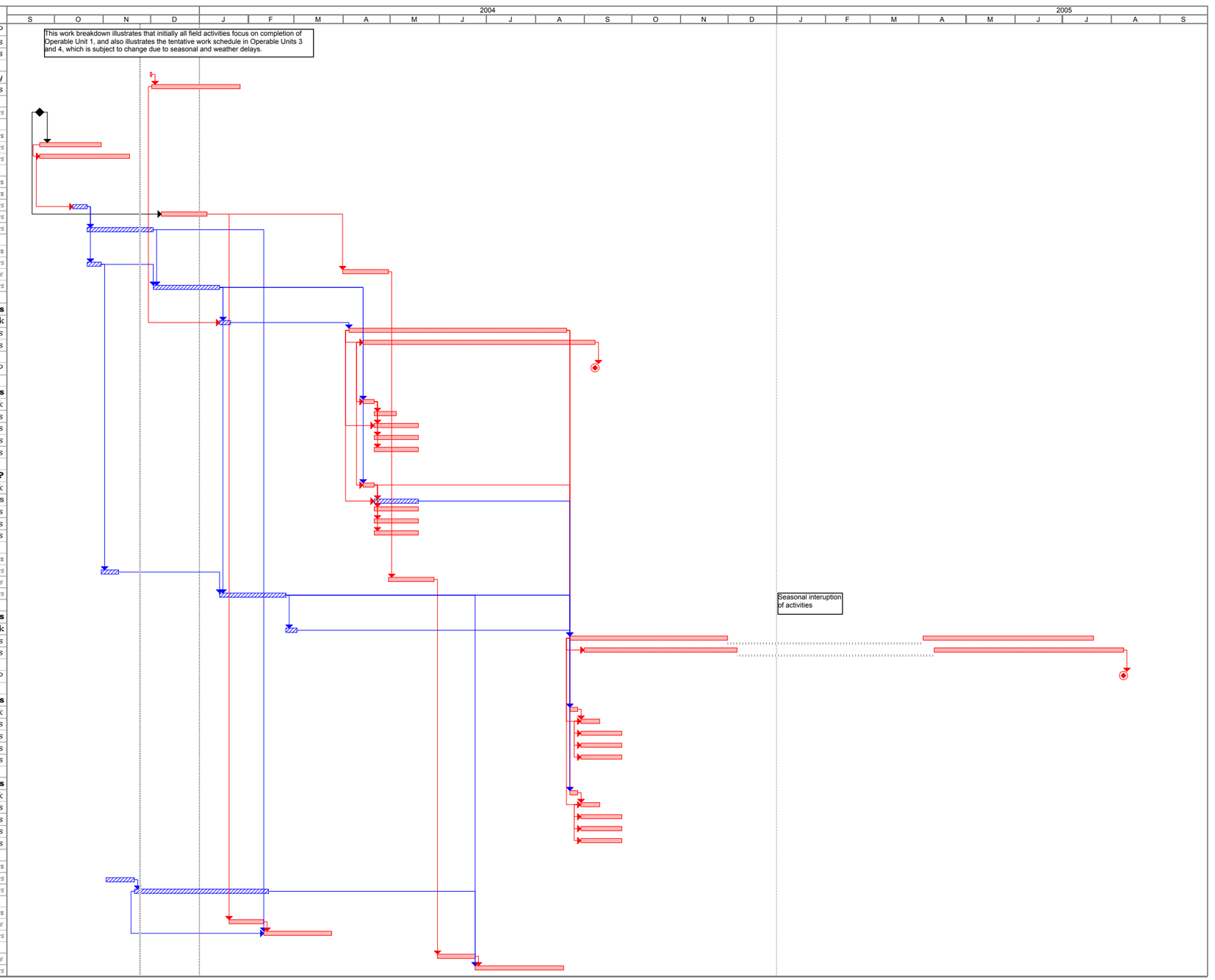

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Figure 3 Location of Operable Units